

67
SEPTEMBER, 1925

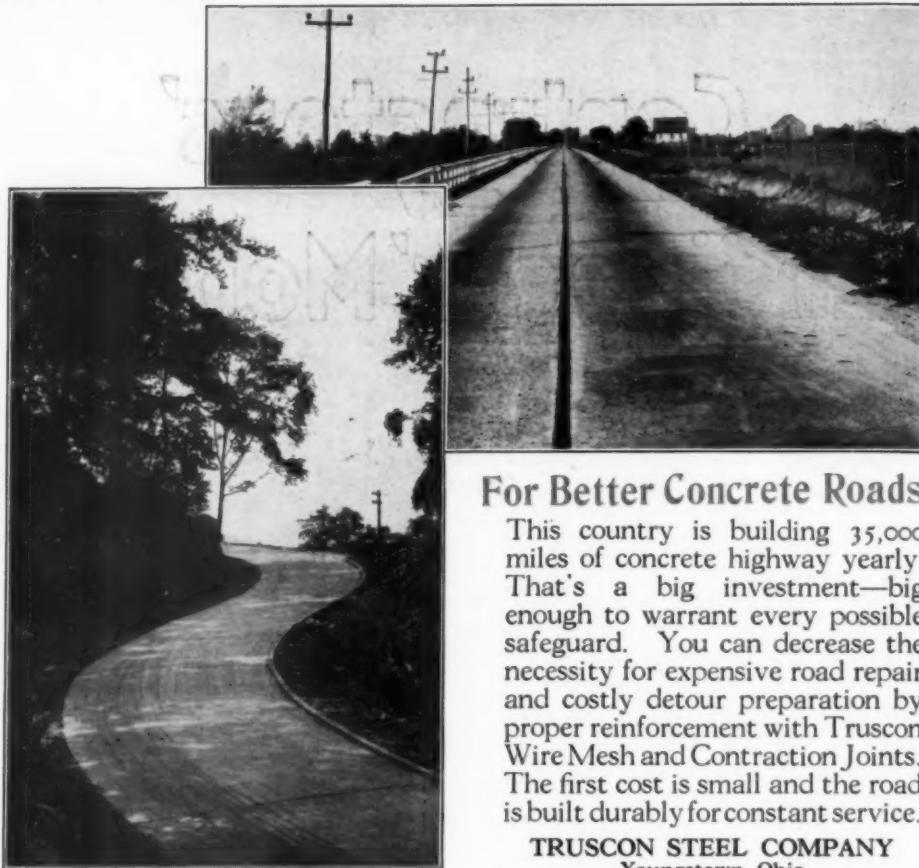
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Contractors' *and* Engineers' Monthly

Building the
Cheyenne Mountain Road
Colorado Springs.





Concrete is the best material and concrete properly reinforced means permanence in road construction.

*Ask for free 80-page book
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The Truscon Contraction Joint is a scientifically designed highway reinforcing product which forms slab divisions in concrete roads. This allows expansion and contraction without breakage in the concrete slab. The right angle shoulder of the Contraction Joint dovetails the slabs so that one cannot rise above those adjacent to it.

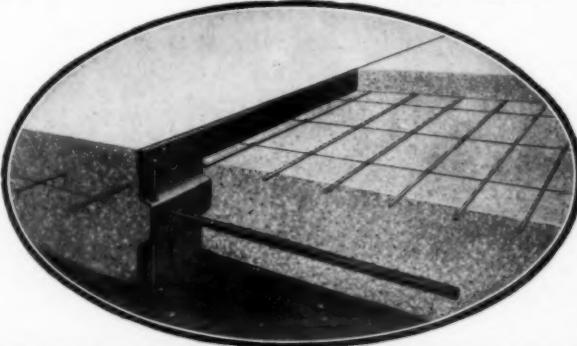
For Better Concrete Roads

This country is building 35,000 miles of concrete highway yearly. That's a big investment—big enough to warrant every possible safeguard. You can decrease the necessity for expensive road repair and costly detour preparation by proper reinforcement with Truscon Wire Mesh and Contraction Joints. The first cost is small and the road is built durably for constant service.

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TRUSCON
TRUSCON CO., INC.
HIGHWAY PRODUCTS



Where to Purchase

A comprehensive classification of the leading machinery and supply manufacturers arranged for the convenience of contractors, engineers and public officials who may wish to secure information about construction equipment.



The Index to Advertisers faces the inside back cover. When writing to advertisers please mention THE CONTRACTOR'S ENGINEERS' MONTHLY. A star (*) before the manufacturer's name indicates that his advertisement appears in this issue.

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**It's as Important to Buy a Mixer
"Right" — as it is to Buy the
Right Mixer**

THE two go together because the mixer of stabilized, unquestioned quality is never forced to make unjust price or "trade" concessions, and in consequence has quick-call, unstinted service behind it when it is actually at work on your job.

No matter where you operate your Koehring—in the sales territory of the Koehring representative from whom you bought it, or in some other representative's territory—there will be the liberal Koehring service behind your Koehring mixer. The Koehring Company cuts neither Koehring Heavy Duty construction nor Koehring service in favor of price! The Koehring Company is more vitally interested in maintaining the Koehring as the mixer of *Profitable Performance*, than in making "price" sales to any individual or in any territory.

Write for Paver Bulletin, No. P. 6

KOEHRING COMPANY

MILWAUKEE, WISCONSIN

*Pavers, Mixers—Gasoline Cranes, Draglines and Shovels
Sales Offices and Service Warehouses in All Principal Cities.
Foreign Department, 105 Front Street, New York City
Canada—Koehring Company of Canada, Ltd.,
105 Front Street, East, Toronto, Ontario
Mexico—P. S. Lapum, Calz De Mayo 21, Mexico, D. F.*

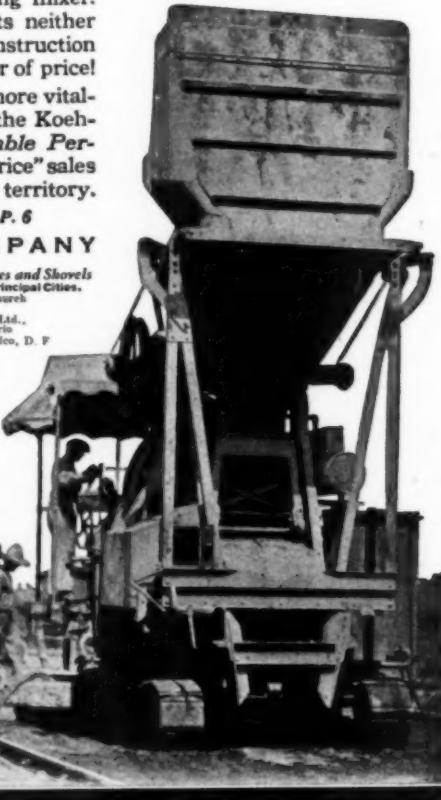
SIZES

Pavers—7-E, 13-E, 21-E. Auxiliary equipment and choice of power to suit individual needs. Complies with A. G. C. Standards.

Construction Mixers—10-S, 14-S, 21-S, 28-S. Steam, gasoline or electric power. Mounted on trucks or skids. Rubber tired wheels optional. 28-S on skids only. Complies with A. G. C. Standards.

Dandie Light Mixer—107-S. Two or four cylinder gasoline engine. Power charging skip, or low charging hopper and platform. Rubber tired steel disc wheels or steel rimmed wheels. Complies with A. G. C. Standards.

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III



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Where to Purchase

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 *Littleford Bros., Cincinnati, O.
 Stuebner Iron Works, G. L., L. I. City, N. Y.

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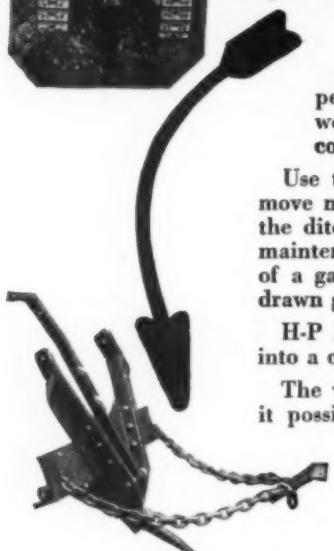
Speeds Up Road Work Another Notch

Fordson power behind a Rooter-equipped H-P "One Man" Grader eats up road work at a phenomenal saving of time and cost.

Use the rooter before the grader blade and move more material per hour. One man does the ditching, rooting, grading, road and street maintenance and snow removal. Saves the work of a gang and four-fifths of the cost of horse-drawn graders.

H-P Rigid Rail Tracks convert the Fordson into a crawler and double its pulling power.

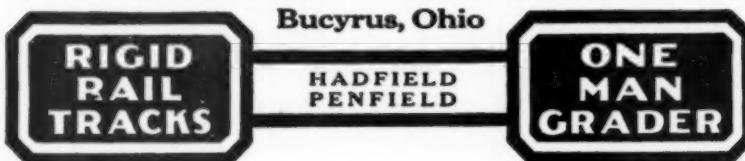
The wonderful power of the Fordson makes it possible for us to attach a Roller back of the "One-Man Grader." This grades the roads, fills the ruts and rolls the road in one operation. The roller can be attached or detached in 15 minutes.



Write for full particulars of our Grader, Scarifier, Roller and Rigid Rail Tracks. They mean money saved. Do it today!

The Hadfield-Penfield Steel Co.

Bucyrus, Ohio



When writing to advertisers, please mention the Contractors' & Engineers' Monthly—Thank you.

Where to Purchase

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- Union Iron Works, Inc., Hoboken, N. J.

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- Easton Car & Const'n Co., Easton, Pa.
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- Elkhart Fdry. & Mach. Co., Elkhart, Ind.
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- Gilbert Mfg. Co., Aberdeen, S. Dak.
- Klauber Mfg. Co., Dubuque, Iowa.
- Madison Foundry Co., Cleveland, O.
- Pechstein Iron Works, Keokuk, Ia.
- Portable Machinery Co., Passaic, N. J.
- Sessions Foundry Co., Bristol, Conn.
- South Bend Foundry Co., South Bend, Ind.

CATCH BASINS (See Castings, Street and Sewer)

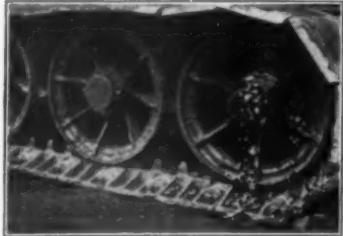
CATCH BASIN CLEANING APPARATUS

- *Mack Trucks, Inc., New York.
- Elgin Sales Corp., New York.

CAULKING MACHINERY AND TOOLS

- Helwig Mfg. Co., St. Paul, Minn.
- Ingersoll-Rand Co., New York.
- Mueller Company, Decatur, Ill.

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Has Self-cleaning Treads and Drive Rollers

Has More Clearance Underneath—Steers in Large or Small Radius Without Stopping—Can be Towed by One Motor Truck—Will Walk Right Up a 30% Grade—Will Travel 1½ Miles per Hour—Will Not Damage Pavements—Can Dig Closer at Either End—Has Tread Pins that Need No Lubrication—The Most Durable Truck Ever Built.

The CENTER DRIVE Does It.

The Busiest Shovel In Town

Traxler's half yard Thew Gasoline Shovel seems to be everywhere in Lorain at once. One day you will see it making the dirt fly in a small cellar excavation, the next you will find it miles away on a street grading job, a small sewer job, a road grading job or in a narrow alley.

Their shovel is one of the babies of the Thew Family. It is always busy because it can work in such cramped or crowded quarters and on small jobs where a larger shovel could not go or would not pay. Then, when through at one place it can gallop quickly away on its Center Drive Truck to another job. It is one man operated and, being gasoline driven, is always ready to go.

For the beginner in the contracting business, or as an auxiliary shovel for owners of larger equipment, this little giant shovel will soon pay for itself and show you the way to greater profits on your season's work.

Let us tell you all about the Thew Type OO Gasoline shovel or ask F. C. Traxler, Lorain, Ohio, to tell you what he thinks of it.

**THE THEW SHOVEL COMPANY,
LORAIN, OHIO**

Thew Lorain Shovels

Dig Faster—Last Longer

Where to Purchase

9

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Berger Mfg. Co., Canton, O.
 Canton Art Metal Co., Canton, O.
 Globe Iron Roofing & Cor. Co., Cincinnati, O.
 Newport Rolling Mill Co., Newport, Ky.
 Klauber Mfg. Co., Dubuque, Iowa.
 Meeker & Co., Geo. L., Evansville, Ind.
 Milwaukee Corrugating Co., Milwaukee, Wis.
 Wheeling Corrugating Co., Wheeling, W. Va.

CEMENT

*Pennsylvania Cement Co., New York.
 *Alta Portland Cement Co., Detroit, Mich.
 Allentown Portland Cement Co., Allentown, Pa.
 Alpha Portland Cement Co., Easton, Pa.
 Ash Grove Lime and Portland Cement Co.,
 Kansas City, Mo.
 Atlas Portland Cement Co., New York.
 Bath Portland Cement Co., Philadelphia, Pa.
 Beaver Portland Cement Co., Portland, Ore.
 Bessemer Limestone and Cement Co., Youngs-
 town, O.
 Canada Cement Co., Ltd., Montreal, Canada.
 Clinchfield Portland Cement Corp., Kingsport,
 Tenn.
 Colorado Portland Cement Co., Denver, Colo.
 Cowell Portland Cement Co., San Francisco, Cal.
 Crescent Portland Cement Co., Wampum, Pa.
 Dewey Portland Cement Co., Kansas City, Mo.
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 Iowa.
 Glens Falls Portland Cement Co., Glens Falls,
 N. Y.
 Golden State Portland Cement Co., Los Angeles,
 Cal.
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 ane, Wash.
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 Louisville Cement Co., Louisville, Ky.
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 Marquette Cement Mfg. Co., Chicago, Ill.
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 Monolith Portland Cement Co., Los Angeles, Cal.
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 New Egyptian Portland Cement Co., Fenton,
 Mich.
 Northwestern States Portland Cement Co., Ma-
 son City, Ia.
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 Mich.
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 Phoenix Portland Cement Co., Nazareth, Pa.
 Portland Cement Co. of Utah, Salt Lake City,
 Utah.
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 Tex.
 Sandusky Cement Co., Cleveland, Ohio.
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 port, Ga.
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 Wolverine Port'l'd Cement Co., Coldwater, Mich.
 Wyandotte Portland Cement Co., Detroit, Mich.

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Cement Gun Co., Allentown, Pa.

CEMENT INSPECTION (See Inspecting Laboratories)

CEMENT TOOLS

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CENTRIFUGAL PUMPS

(See "Pumps, Centrifugal")

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 Del.
 Electro Bleaching Gas Co., New York.
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 Rust Engineering Co., Pittsburgh, Pa.
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 Alphons Custodis Chimney Const. Co., New York.
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CHLORINE, LIQUID (See Liquid Chlorine)

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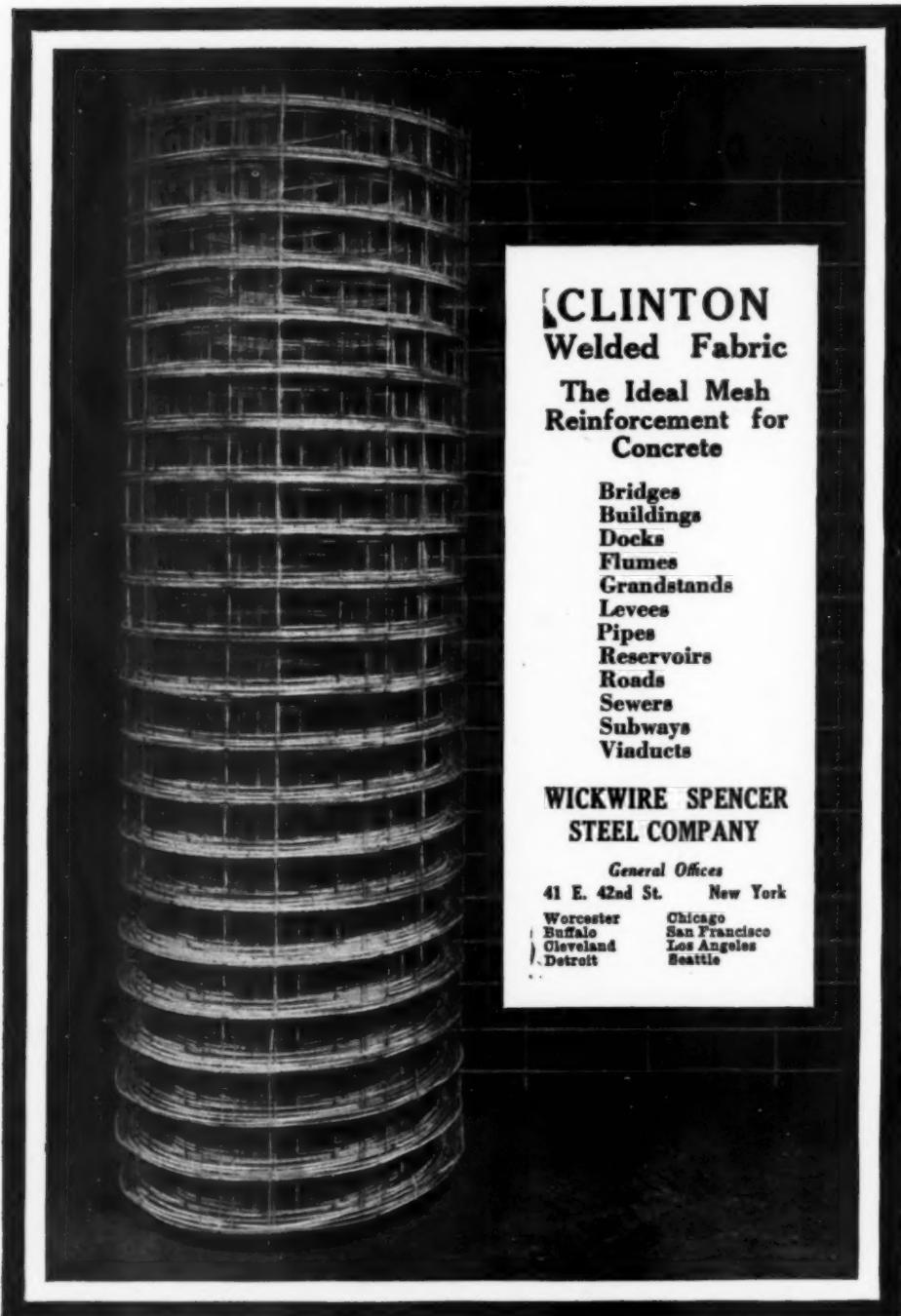
American Hoist & Derrick Co., St. Paul, Minn.
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 Mockbee & Co., C. M., Cincinnati, O.
 John A. Roebling Sons Co., Trenton, N. J.
 Upson-Walton Co., Cleveland, O.

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- Chain Belt Co., Milwaukee, Wis.
- Fairfield Engineering Co., Marion, Ohio
- Gifford-Wood Co., Hudson, N. Y.
- Green, L. F., Chicago, Ill.
- Hunt Co., Inc., O. W., West New Brighton, N. Y.
- Jeffrey Mfg. Co., Columbus, O.
- Kon-Wald Co., Buffalo, N. Y.
- Link-Belt Co., Chicago, Ill.
- Portable Machinery Co., Passaic, N. J.
- Robins Conv. Belt Co., New York
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- Weller Mfg. Co., Chicago, Ill.

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- Mueller Company, Decatur, Ill.

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- *Universal Form Clamp Co., Chicago, Ill.
- The O. D. G. Co., Owensboro, Ky.
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- Symons Clamp & Mfg. Co., Chicago, Ill.

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- *Koehring Co., Milwaukee, Wis.
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- *Lakewood Engineering Co., Cleveland, O.
- Lansing Co., Lansing, Mich.
- *Marsh-Carpon Co., Chicago, Ill.
- *Raber & Lang Mfg. Co., Kendallville, Ind.
- *Smith Co., T. L., Milwaukee, Wis.
- Anchor Mfg. Co., Chicago, Ill.
- Badger Concrete Mixer Co., Milwaukee, Wis.
- Chain Belt Co., Milwaukee, Wis.
- Contractors' Equipment Co., Keokuk, Ia.
- B. M. Cropp Co., Chicago, Ill.
- Foot Concrete Machy. Co., Chicago, Ill.
- Gray Iron Fdry Co., Reading, Pa.
- Judy Mfg. Co., Centerville, Ia.
- Knickerbocker Co., Jackson, Mich.
- Leach Co., Oshkosh, Wis.
- Milwaukee Concrete Mixer Co., Milwaukee, Wis.
- Ransome Concrete Machy. Co., Dunellen, N. J.
- Republic Iron Works, Tecumseh, Mich.
- Schramm, Inc., West Chester, Pa.
- Standard Scale & Supply Co., Pittsburgh, Pa.
- Truckmixer Co., Milwaukee, Wis.
- Worthington Pump & Mach'y Corp., New York.

CONCRETE PILING. (See Piling, Concrete)

CONCRETE PIPE (See Pipe, Reinforced Concrete)

CONCRETE REINFORCEMENT

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- *Wickwire Spencer Steel Co., Inc., New York
- American Steel & Wire Co., Chicago, Ill.
- Bothlehem Steel Co., Bothlehem, Pa.
- Carnegie Steel Co., Pittsburgh, Pa.
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- Electric Welding Co., Pittsburgh, Pa.
- General Fireproofing Co., Youngstown, O.
- Inland Steel Co., Chicago, Ill.
- Kalman Steel Co., Chicago, Ill.
- Laclede Steel Co., St. Louis, Mo.
- National Steel Fabric Co., Pittsburgh, Pa.
- Ryerson & Son, J. T., Chicago, Ill.
- Youngstown Pressed Steel Co., Warren, O.
- Youngstown Sheet & Tube Co., Youngstown, O.

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- *French & Co., A. W., Chicago, Ill.
- *Heitzei Steel Form & Iron Co., Warren, O.
- Lakewood Engineering Co., Cleveland, O.
- Dunn Road Mach. Co., Conneaut, Ohio.

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- *Concrete Surfacing Machy. Corp., Cincinnati, O.

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(See pages 121, 139)

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- *Russell Grader Mfg. Co., Minneapolis, Minn.
- Brown Hoisting Machy. Co., Cleveland, O.
- Chain Belt Co., Milwaukee, Wis.
- Gifford Wood Co., Hudson, N. Y.
- Jeffrey Mfg. Co., Columbus, O.
- Link-Belt Co., Chicago, Ill.
- Olson & Co., Sam'l, Chicago, Ill.
- Portable Machinery Co., Passaic, N. J.
- Robins Conv. Belt Co., New York.
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- Brown Hoisting Machy. Co., Cleveland, O.
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- Chain Belt Co., Milwaukee, Wis.
- Fairfield Engineering Co., Marion, Ohio
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- Godfrey Conveyor Co., Elkhart, Ind.
- Guarantee Constrn. Co., New York.
- Jeffrey Mfg. Co., Columbus, O.
- Link-Belt Co., Chicago, Ill.
- Olson & Co., Sam'l, Chicago, Ill.
- Republic Rubber Co., Youngstown, O.
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- Lamson Co., Syracuse, N. Y.
- Mathews Gravity Carrier Co., Elwood City, Pa.
- Standard Conveyor Co., No. St. Paul, Minn.

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- Ingersoll-Rand Co., New York.

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*Above: East River Drive, Olean, N. Y.
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Lower right: Road gang widening old pavement with "Tarvia K-P" mix.

Upper Left: Grand Concourse and Boulevard, New York City. "Tarvia-B" since 1911.

Tarvia
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Chapter IX

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- *Koehring Co., Milwaukee, Wis.
- *Osgood Co., The Marion, O.
- *Trew Shovel Co., Lorain, O.
- American Hoist & Derrick Co., St. Paul, Minn.
- Brown Hoisting Mch'y. Co., Cleveland, O.
- Browning Co., Cleveland, O.
- Bucyrus Co., South Milwaukee, Wis.
- Davenport Locomotive Works, Davenport, Ia.
- Erie Steam Shovel Co., Erie, Pa.
- Hanna Eng. Works, Chicago, Ill.
- Industrial Works, Bay City, Mich.
- Link-Belt Co., Chicago, Ill.
- Locomotive Crane Co. of America, Champaign, Ill.
- Marion Steam Shovel Co., Marion, O.
- McMyler Interstate Co., Cleveland, O.
- Northwest Engineering Works, Chicago, Ill.
- Orton & Steinbrenner Co., Chicago, Ill.
- Ohio Locomotive Crane Co., Bucyrus, O.
- U. S. Crane Co., Chicago, Ill.

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- *Industrial Plants Corp'n, Toledo, O.
- Alliance Machine Co., Alliance, O.
- Chesapeake Iron Wks., Baltimore, Md.
- Chisholm-Moore Mfg. Co., Cleveland, Ohio.
- Milwaukee Electric Crane Co., Milwaukee, Wis.
- Morgan Engineering Co., Alliance, O.
- Northern Eng. Works, Detroit, Mich.
- Shaw Crane Works, Muskegon, Mich.
- Shepard Elec. Cr. & Hst. Co., Montour Falls, N.Y.
- Toledo Crane Co., Bucyrus, O.
- Whiting Fdry. & Equip. Co., Harvey, Ill.

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- *Byers Machine Co., Ravenna, Ohio
- *Harnischfeger Corp., Milwaukee, Wis.
- *Industrial Plants Corp'n, Toledo, O.
- Bay City Fdry. & Mach. Co., Bay City, Mich.
- Universal Crane Co., Cleveland, Ohio

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 - *Austin-Western Road Mach. Co., Chicago, Ill.
 - *Good Roads Machy. Co., Kennett Square, Pa.
 - *E Russell Grader Mfg. Co., Minneapolis, Minn.
 - *Universal Road Machinery Co., Kingston, N. Y.
 - Galion Iron Works & Mfg. Co., Galion, Ohio
 - Morgan Engineering Co., Alliance, O.
 - New Holland Mach. Co., New Holland, Pa.
 - Smith Eng. Wks., Milwaukee, Wis.
 - Startevans Mill Co., Boston, Mass.
 - Universal Crusher Co., Cedar Rapids, Ia.

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- Wood & Co., R. D., Philadelphia, Pa.

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- Klauder Mfg. Co., Dubuque, Ia.
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- Northfield Iron Co., Northfield, Minn.
- Southern Metal Culvert Co., Salisbury, N. C.
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- Northfield Iron Co., Northfield, Minn.

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- Mueller Co., Decatur, Ill.

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CURB, STEEL PROTECTED

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- Concrete Sign Co., New York.
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- Greenfield Tap & Die Corp'n, Greenfield, Mass.
- Oswego Tool Co., Oswego, N. Y.
- Reed Mfg. Co., Erie, Pa.
- Walworth Mfg. Co., Boston, Mass.

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- Carolus Mfg. Co., Sterling, Ill.
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- Shank Mfg. Co., Bucyrus, O.

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- *Milburn Co., Alexander, Baltimore, Md.
- MacLeod Co., Cincinnati, O.

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- American Hoist & Derrick Co., St. Paul, Minn.
- Federal Bridge & Struc. Co., Waukesha, Wis.
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Insley Concrete Placing Equipment and Steel Derricks



N THE Exchequer Dam across the Merced River in California, Bent Brothers, Inc., of Los Angeles, the contractors, are placing between 1600 and 2100 cubic yards of concrete per day.

Insley Steel Tower Chuting Equipment is used throughout for handling the concrete and Insley Steel Derricks are used for handling the forms.

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- *Dobbs Fdry. & Mach. Co., Niagara Falls, N. Y.
- *Lidgerwood Manufacturing Co., New York
- American Hoist & Derrick Co., St. Paul, Minn.

DERRICKS, TRAVELING

- *Bay City Dredge Works, Bay City, Mich.
- *Clyde Iron Wks. Sales Co., Duluth, Minn.
- *Dobbs Fdry. & Mach. Co., Niagara Falls, N. Y.
- American Hoist & Derrick Co., St. Paul, Minn.
- Austin Machinery Corp'n, Muskegon, Mich.
- Hayward Co., New York.
- Nat'l Hoisting Engine Co., Harrison, N. J.
- Orton & Steinbrenner Co., Chicago, Ill.

DERRICK FITTINGS

- *S. Flory Mfg. Co., Bangor, Pa.
- *Lidgerwood Mfg. Co., New York

DIESEL ENGINES. (See Engines, Oil)

DISTRIBUTORS, TAR AND ASPHALT

- *Kinney Mfg. Co., Boston, Mass.

DISTRIBUTING PLANTS, CONCRETE

- *Archer Iron Works, Chicago, Ill.
- *Lakewood Engineering Co., Cleveland, O.
- *Inley Mfg. Co., Indianapolis, Ind.
- Ransome Concrete Mch'y. Co., Dunellen, N. J.

DITCHING MACHINES. (See Excavators, Ditch and Trench)

DIVIDING PLATES (ROAD)

- *Gedwin Co., W. S., Baltimore, Md.

DOORS AND SHUTTERS, STEEL ROLLING

- Cornell Iron Works, Inc., New York.
- Kinnear Mfg. Co., Columbus, O.
- Variety Fire Door Co., Chicago, Ill.
- Wilson Corp., J. G., New York.

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- Universal Drafting Machine Co., Cleveland, O.

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- *Ames Shovel & Tool Co., Boston, Mass.
- *Geo. Griffiths Co., Cheltenham, Pa.
- *The H. M. Myers Co., Beaver Falls, Pa.
- *T. Bowland's Sons, Inc., Cheltenham, Pa.
- *St. Louis Shovel Co., Plant, St. Louis, Mo.
- *Wright Shovel Co., Andersen, Ind.

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- *Bay City Dredge Works, Bay City, Mich.
- *Lidgerwood Manufacturing Co., New York
- *Michigan Dredge Co., Bay City, Mich.
- Osgood Co., The, Marion, O.
- American Steel Dredge Co., Fort Wayne, Ind.
- Bucyrus Co., South Milwaukee, Wis.
- Elliot Machine Corp'n, Baltimore, Md.
- Erie Steam Shovel Co., Erie, Pa.
- Hayward Co., New York.
- Marion Steam Shovel Co., Marion, O.
- Stockton Iron Works, Stockton, Cal.
- Street Bros. Machine Works, Chattanooga, Tenn.
- Superior Iron Works, Superior, Wis.

DREDGES, DIPPER

- *Bay City Dredge Works, Bay City, Mich.
- Osgood Co., Marion, O.
- American Steel Dredge Co., Fort Wayne, Ind.
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- Bucyrus Co., South Milwaukee, Wis.
- Fairbanks Steam Shovel Co., Marion, O.
- Marion Steam Shovel Co., Marion, O.

DREDGES, HYDRAULIC

- Bucyrus Co., South Milwaukee, Wis.
- Elliot Mach. Corp., Baltimore, Md.
- Fairbanks Steam Shovel Co., Marion, O.
- Marion Steam Shovel Co., Marion, O.
- Morris Machine Works, Baldwinsville, N. Y.

DREDGING MACHINERY

- *S. Flory Mfg. Co., Bangor, Pa.
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DREDGING PUMPS AND ACCESSORIES

- Erie Pump & Engine Wks., Medina, N. Y.

DRILLS, AIR AND ROCK

- *Dallert Co., The, Philadelphia, Pa.
- *Denver Rock Drill Mfg. Co., Denver, Colo.
- *McKiernan-Terry Drill Co., New York.
- *Sullivan Machinery Co., Chicago, Ill.
- *Wood Drill Wks., Paterson, N. J.
- Chicago Pneumatic Tool Co., New York.
- Cleveland Pneumatic Tool Co., Cleveland, Ohio.
- Cleveland Rock Drill Co., Cleveland, Ohio.
- Helwig Mfg. Co., St. Paul, Minn.
- Independent Pneumatic Tool Co., Chicago, Ill.
- Ingersoll-Rand Co., New York.

DRILLS, CORE

- *McKiernan-Terry Drill Co., New York.
- *Standard Diamond Drill Co., Chicago, Ill.
- *Sullivan Machinery Co., Chicago, Ill.
- Dobbs Core Drill Co., Inc., New York.
- Ingersoll-Rand Co., New York.

DRILLS, HAMMER (PNEUMATIC)

- *Denver Rock Drill Mfg. Co., Denver, Colo.
- *McKiernan-Terry Drill Co., New York.
- *Sullivan Machinery Co., Chicago, Ill.
- *Wood Drill Works, Paterson, N. J.
- Chicago Pneumatic Tool Co., New York.
- Cleveland Pneumatic Tool Co., Cleveland, O.
- Cleveland Rock Drill Co., Cleveland, O.
- Helwig Mfg. Co., St. Paul, Minn.
- Ingersoll-Rand Co., New York.

DRILLS FOR WELLS AND BLAST HOLES (See Well Drilling Machinery)

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- *Blaw-Knox Co., Pittsburgh, Pa.
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- *Dobbs Fdry. & Mach. Co., Niagara Falls, N. Y.
- Hayward Co., New York.
- Monighan Machine Co., Chicago, Ill.

DRYERS, ASPHALT AND CEMENT

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- American Blower Co., Detroit, Mich.
- American Process Co., New York.
- Atlas Dryer Co., Cleveland, O.
- Bartlett & Snow Co., C. O., Cleveland, O.
- Cummer & Son Co., F. D., Cleveland, O.
- Ruggles-Coles Eng. Co., New York.

DRYERS, SAND AND GRAVEL

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- *Littleford Bros., Cincinnati, Ohio.
- Bartlett & Snow Co., C. O., Cleveland, Ohio.
- Chase & Lyman, Boston, Mass.

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- *Heil Company, Milwaukee, Wis.
- *The Hug Co., Highland, Ill.
- *Hughes-Keanan Co., Mansfield, Ohio
- *Inley Mfg. Co., Indianapolis, Ind.
- *Littleford Bros., Cincinnati, O.
- *Mack Trucks, Inc., New York.
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- *Superior Body Corp'n, Marion, Ind.
- *Stewart Iron Wks. Co., Cincinnati, Ohio
- *Wood Hydr. Hoist & Body Co., Detroit, Mich.
- American Truck & Body Co., Martinsville, Va.
- Columbia Body Corp., Columbia, Pa.
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- Eastern Car & Const'n Co., Easton, Pa.
- Galion All Steel Body Co., Galion, Ohio.
- Griscom-Russell Co., New York.
- Herr Dump Car Mfg. Co., Coatesville, Pa.
- Jennings Automatic Dump Body, Roanoke, Va.
- Lee Trailer & Body Co., Chicago, Ill.
- Mandt Body Co., Keokuk, Iowa.
- Peckstein Iron Works, Keokuk, Iowa.
- Van Dorn Iron Wks., Cleveland, Ohio.

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- *Austin-Western Road Machy. Co., Chicago, Ill.
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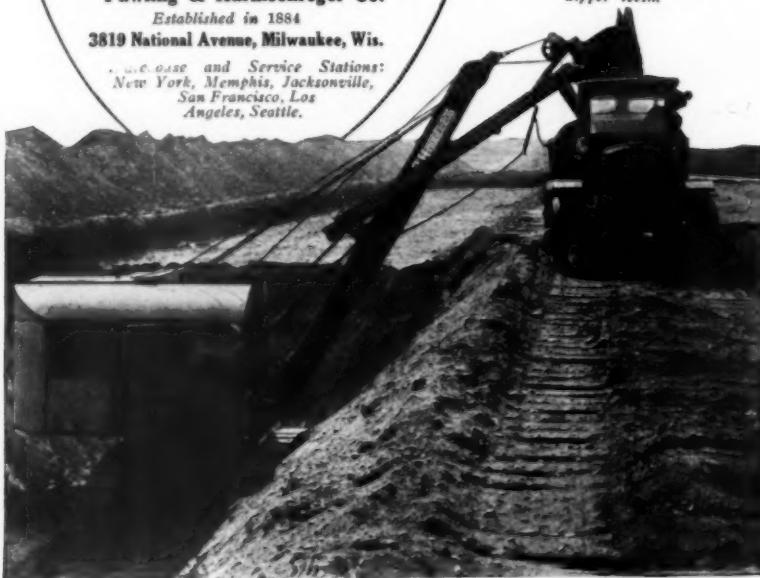
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Note how trucks are loaded from below—26 ft. to dipper teeth.



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 La Plant-Choate Mfg. Co., Cedar Rapids, Iowa
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 Watson Products Corp., Canastota, N. Y.

DUST LAYING (CALCIUM CHLORIDE)
 *Dow Chemical Co., Midland, Mich.
 *Solvay Process Co., New York
 Carbonate Calcium Co., Carbondale, Pa.

DYNAMITE (See Explosives)

JECTORS, SEWAGE (See Sewage Ejectors)

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 Crocker-Wheeler Co., Ampere, N. J.
 Fairbanks, Morse & Co., Chicago, Ill.
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 Idea Elec. & Mfg. Co., Mansfield, O.
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 *Spears-Wells Mach'y Co., Oakland, Cal.
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 Olson & Co., Sam'l, Chicago, Ill.
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 Weller Mfg. Co., Chicago, Ill.
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 Ridgway & Son Co., C. Coatesville, Pa.
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 Fairbanks, Morse & Co., Chicago, Ill.
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 Fuller & Johnson Mfg. Co., Madison, Wis.
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(See Hoists)

ENGINES, KEROSENE

*Alamo Engine Co., Hillsdale, Mich.
 *Climax Engineering Co., Clinton, Iowa

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DIESEL
 *Hadfield-Penfield Steel Co., Bucyrus, Ohio
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 Busch-Sulzer Bros.-Diesel Eng. Co., St. Louis, Mo.
 Fulton Iron Works Co., St. Louis, Mo.
 McIntosh & Seymour Corp., Auburn, N. Y.
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 Western Machy. Co., Los Angeles, Cal.

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Anderson Flyer & Mach. Co., Anderson, Ind.
 Bessemer Gas Eng. Co., Grove City, Pa.
 Buckeye Machinery Co., Lima, O.
 Charter Gas Eng. Co., Sterling, Ill.
 Chicago Pneumatic Tool Co., New York.
 De La Vergne Machine Co., New York.
 Fairbanks, Morse & Co., Chicago, Ill.
 Foss Gas Engine Co., Springfield, Ohio.
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 Muncie Oil Eng. Co., Muncie, Ind.
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 Nordberg Mfg. Co., Milwaukee, Wis.
 Stover Mfg. & Engine Co., Freeport, Ill.
 Taylor Machine Co., Cleveland, O.
 Weber Engine Co., Kansas City, Mo.
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*Dake Engine Co., Grand Haven, Mich.
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 Loffel Co., J., Springfield, O.
 Morris Machine Works, Baldwinsville, N. Y.
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19

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- Bucyrus Co., South Milwaukee, Wis.

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- Economy Excavator Co., Iowa Falls, Ia.
- Erie Steam Shovel Co., Erie, Pa.
- Fairbanks Steam Shovel Co., Marion, O.
- Hayward Co., The New York City.
- Marion Steam Shovel Co., Marion, O.
- Monaghan Machine Co., Chicago, Ill.
- Owensboro Ditcher & Grader Co., Owensboro, Ky.
- Parsons Co., Newton, Ia.
- Speeder Mach'y Corp., Fairfield, Iowa
- Tepping Machy. Co., Chas. T. Dayton, O.

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- *Lidgerwood Mfg. Co., New York
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- *Russell Grader Mfg. Co., Minneapolis, Minn.
- *Sauermaier Bros., Chicago, Ill.
- *Smith Co., T. L., Milwaukee, Wis.
- *Thew Shovel Co., Lorain, Ohio
- Austin Machinery Corp., Muskegon, Mich.
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- Bucyrus Co., South Milwaukee, Wis.
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- Erie Steam Shovel Co., Erie, Pa.
- Gade Excavator Works, C. L., Iowa Falls, Iowa.
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- Hayward Co., New York.
- Industrial Works, Bay City, Mich.
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- Nitselman Bros., Muncie, Ind.
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- Van Dorn Iron Works, Cleveland, O.

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- Pirsch & Sons Co., Peter, Kenosha, Wis.
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- Seagrave Co., Columbus, O.
- Stuts Fire Engine Co., Indianapolis, Ind.
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- Kearns & Mattison Co., Ambler, Pa.
- Kinnear Mfg. Co., Columbus, O.
- National Fireproofing Co., Pittsburgh, Pa.
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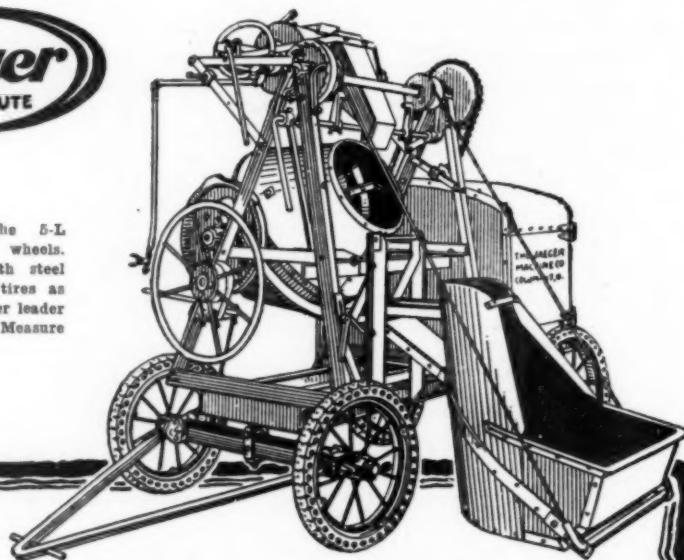
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- *Barrett Co., New York
- Am. Mason Safety Tread Co., Lowell, Mass.
- Johns-Manville, Inc., New York.
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Perfect Concrete at "Mix-a-Minute" Speed!

Speed that makes profits on every mix! Dependable performance at all times! Low cost of operation! And perfectly mixed concrete! These are the remarkable advantages a Jaeger Mixer brings you.

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Columbus, Ohio

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- Jennison-Wright Co., Toledo, O.
- Midland Creosoting Co., Toledo, O.
- Republie Creosoting Co., Indianapolis, Ind.
- Sou. Wood Preserving Co., Atlanta, Ga.
- Wyckoff Pipe & Creosoting Co., New York.

FLUSH TANKS

- *Pacific Flush Tank Co., Chicago and New York
- FLUSHERS, STREET. (See Street Flushers and Sprinklers.)

FORD AND FORDSON EQUIPMENT

- AIR COMPRESSORS FOR FORDSONS
- *Curtis Pneumatic Machinery Co., St. Louis, Mo.
- Schramm, Inc., Westchester, Pa.

AIR COMPRESSORS FOR FORD TRUCKS

- *Domestic Engine & Pump Co., Shippensburg, Pa.
- Schramm, Inc., Westchester, Pa.

CONCRETE MIXERS ON FORD TRUCKS

- *American Cement Machine Co., Keokuk, Iowa
- *Archer Iron Works, Chicago, Ill.
- Milwaukee Concrete Mixer Co., Milwaukee, Wis.

DUMP BODIES FOR FORD TRUCKS

- *Archer Iron Works, Chicago, Ill.
- Hill Co., Milwaukee, Wis.
- *Herr Dump Body Mfg. Co., Coatesville, Pa.
- Hughes-Keenan Co., Mansfield, Ohio.
- *Marion Steel Body Co., Marion, Ohio
- *Stewart Iron Works Co., Cincinnati, Ohio
- *Superior Boiler Works, Marion, Ind.
- *Wood Hydr. Hoist & Body Co., Detroit, Mich.
- American Production & Trading Co., Chicago, Ill.
- Anthony Co., Streator, Ill.
- Columbian Steel Tank Co., Kansas City, Mo.
- Ditwiler Mfg. Co., Galion, Ohio
- Eagle Wagon Works, Auburn, N. Y.
- Easton Car & Const'n Co., Easton, Pa.
- Galion All Steel Body Co., Galion, O.
- Griseom-Russell, New York.
- Jennings Auto Dump Body Co., Roanoke, Va.
- Lee Trailer & Body Co., Chicago, Ill.
- Mandt Co., Keokuk, Iowa.
- Martin-Party Corp., York, Pa.
- N. Y. Cent. Iron Wks. Co., Inc., Hagerstown, Md.
- Pechstein Iron Works, Keokuk, Iowa.
- Thompson Mfg. Co., Williston, S. C.
- Van Dorn Iron Works, Cleveland, Ohio.

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- *American Steam Pump Co., Battle Creek, Mich.

FORD PLOWS

- Roderick Lean Mfg. Co., Mansfield, Ohio.

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- Warford Corp., New York

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- Chas. T. Topping, Dayton, O.

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- *Clyde Iron Works Sales Co., Duluth, Minn.
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- Oklahoma Eng. & Fdry. Co., Muskogee, Okla.
- Otis Engine Corp., New York.
- Sheffield Tool & Supply Co., Sheffield, Pa.

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- Brookville Truck & Tractor Co., Brookville, Pa.
- Whitehead & Kales Co., Detroit, Mich.

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- Fairbanks Steam Shovel Co., Marion, Ohio
- Glasgow Engineering Company, St. Louis, Mo.
- Mandt Company, The, Keokuk, Iowa.
- Milwaukee Electric Crane & Mfg. Co., Milwaukee, Wis.

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- *Russell Grader Mfg. Co., Minneapolis, Minn.
- *Shaw-Enoch's Tractor Co., Minneapolis, Minn.

- Adams, J. D. & Co., Indianapolis, Ind.
- Gilbert Mfg. Co., Aberdeen, S. D.
- Wehr Co., Milwaukee, Wis.

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- *Acme Road Mach'y Co., Frankfort, N. Y.
- *Austin-Western Road Mach. Co., Chicago, Ill.
- *Good Roads Mach'y Co., Kennett Square, Pa.
- Galion Iron Works & Mfg. Co., Galion, Ohio
- Horst & Strietzel Co., Davenport, Iowa

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- *Amer. Saw Mill Mach'y Co., Hackettstown, N. J.
- *Miami Trailor-Scraper Co., Troy, Ohio

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- *Miami Trailor-Scraper Co., Troy, Ohio
- Miskin Scraper Works, Ucon, Idaho.
- Gustav Schaefer Wagon Co., Cleveland, O.

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- *Tractor Grip Wheel Co., Toledo, Ohio
- Full-Crawler Co., Milwaukee, Wis.
- A. C. Johnson Products, Racine, Wis.

FORDSON TRACTOR TRUCKS

- Topping Tractor Truck Co., Appleton, Wis.

FORDSON TRAILER EQUIPMENT

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- Easton Car & Const'n Co., Easton, Pa.
- Trail-Ford Corp., Ann Arbor, Mich.
- Trailmobile Co., Cincinnati, O.
- Troy Trailer & Wagon Co., Troy, O.
- Whitehead & Kales Co., Detroit, Mich.

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- *Spears-Wells Mach'y Co., Oakland, Cal.
- Leesman Loader Mfg. Co., Des Moines, Iowa.
- N. P. Nelson Iron Works, Brooklyn, N. Y.
- Specialty Engineering Co., Philadelphia, Pa.

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- Buffalo Forge Co., Buffalo, N. Y.
- Champion Blower & Forge Co., Lancaster, Pa.
- Hauke Mfg. Co., Brooklyn, N. Y.

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- *Lakewood Engineering Co., Cleveland, O.
- *Raber & Lang Mfg. Co., Kendallville, Ind.
- *Truscon Steel Co., Youngstown, O.
- Concrete Form Co., Inc., Syracuse, N. Y.
- Hotchkiss Steel Products Co., Binghamton, N. Y.
- Metal Forms Corp., Milwaukee, Wis.

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- Clow & Sons, Jas. B., Chicago, Ill.
- Crane Co., Chicago, Ill.
- Mott Iron Wks., J. L., New York.
- Murdock Mfg. & Supply Co., Cincinnati, Ohio
- Puro San. Dr. Pta. Co., Haydenville, Mass.
- Rundle-Spence Mfg. Co., Milwaukee, Wis.
- Stewart Iron Works Co., Cincinnati, O.
- Taylor Co., Halsey W., Warren, O.
- Twentieth Century Brass Wks., Belleville, Ill.

FURNITURE AND FILES, STEEL

- Art Metal Constrn. Co., Jamestown, N. Y.
- General Fireproofing Co., Youngstown, O.
- Van Dorn Iron Works Co., Cleveland, O.

FURRING AND SLEEPER ANCHORS

- Dayton Sure Grip & Shore Co., Dayton, Ohio

GARBAGE CANS. (See Cans)

GARBAGE DISPOSAL

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- Balmer Corp., New York.
- Bartlett, C. O. & Snow Co., Cleveland, O.
- Decarie Incinerator Co., Long Island City, N. Y.

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McKiernan-Terry pile hammer equipment covers the entire range of pile driving work, from the heaviest concrete bearing piles to the lightest wooden sheeting. Even in countries like Japan and India, where labor is cheap, McKiernan-Terry Pile Hammers are used in preference to mauls or light drop hammers, because they are more economical, faster, and better in every way.

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Left.—No. 3 Pile Hammer driving 3 x 10-inch wood sheeting spliced to 34-foot lengths. Right.—McKiernan-Terry No. 3 Pile Hammer driving two 7-inch steel sheet sections at one time within $\frac{1}{4}$ inch of a wall.



McKiernan-Terry Pile Hammers

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Hiller Eng. & Const. Co., Brooklyn, N. Y.
Morse-Boulger Destructor Co., New York
Nye Odorless Crematory Co., Macon, Ga.

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Holzbog & Bro., Geo. H., Jeffersonville, Ind.
Lee Trailer & Body Co., Chicago, Ill.
Rifkin Wagon Co., Tiffin, O.
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GAS PRODUCERS
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Wood & Co., R. D., Philadelphia, Pa.

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Birmingham Tank Co., Birmingham, Ala.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Chicago Bridge & Iron Works, Chicago, Ill.
Graver Corp., East Chicago, Ind.
Scotte & Sons, Wm. B., Oakmont, Pa.
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United Iron Works, Inc., Kansas City, Mo.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

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Hardesty Mfg. Co., R., Denver, Colo.

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*Pickering Governor Co., Portland, Conn.

GRADERS, ROAD (See "Road Graders.")

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Adams & Co., J. D., Indianapolis, Ind.
Shuler Mfg. Co., Bucyrus, Ohio

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Ingersoll-Rand Co., New York.

GYPSUM PRODUCTS

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HAMMER DRILLS

(See Drills, Hammer.)

HAMMERS, STEAM, PILE. (See Pile Hammers, Steam.)

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Johns-Manville, Inc., New York.

HEATING KETTLES. (See Kettles)

HITCHES

Schaefer Wagon Co., Gustav, Cleveland, Ohio

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*Harnischfeger Corp., Milwaukee, Wis.
*Lidgerwood Manufacturing Co., New York
*Mead-Morrison Mfg. Co., E. Boston, Mass.
American Hoist & Derrick Co., St. Paul, Minn.
Amer. Sew Mill Mach'y Co., Hackettstown, N. J.
Mundy Hoisting Engine Co., J. S., Newark, N. J.

Street Bros. Mach. Wks., Chattanooga, Tenn.
Weller Mfg. Co., Chicago, Ill.

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*Lakewood Engineering Co., Cleveland, O.
*Lidgerwood Mfg. Co., New York
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Ransome Concrete Machy. Co., Dunellen, N. J.

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Chisholm-Moore Mfg. Co., Cleveland, Ohio.
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*Construction Machy. Co., Waterloo, Iowa
*Domestic Engine & Pump Co., Shippensburg, Pa.
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*Lansing Co., Lansing, Mich.
*Lidgerwood Manufacturing Co., New York
*Mead-Morrison Mfg. Co., E. Boston, Mass.
*Novo Engine Co., Lansing, Mich.
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Hanna Eng. Works, Chicago, Ill.
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Northern Engineering Works, Detroit, Mich.
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*Lidgerwood Manufacturing Co., New York
*Mead-Morrison Mfg. Co., E. Boston, Mass.
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Orr & Sembower, Reading, Pa.
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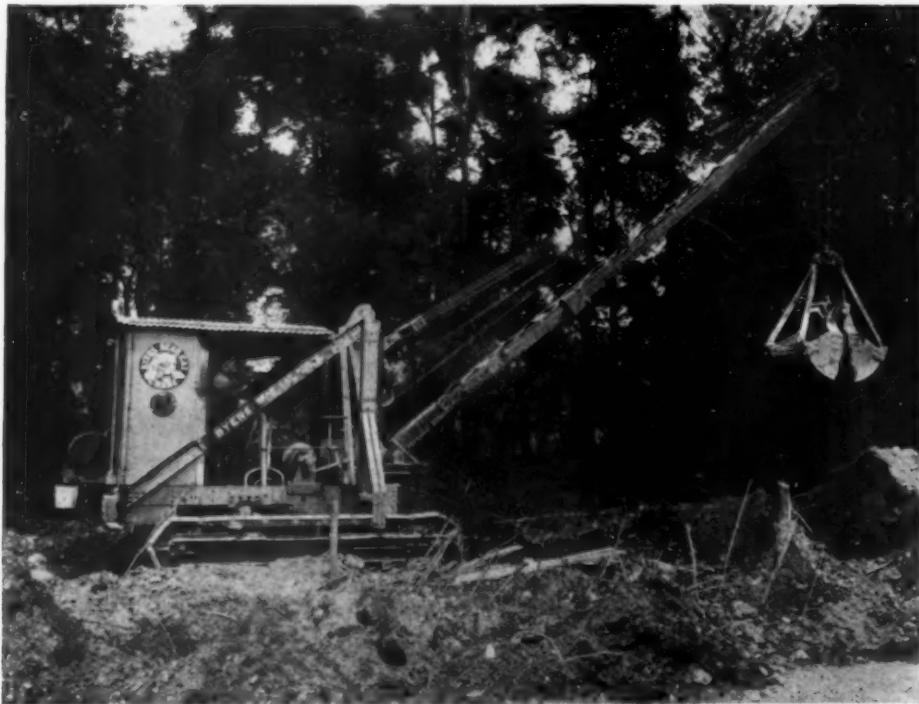
HOISTS FOR MOTOR TRUCKS

*Hell Co., The, Milwaukee, Wis.
*Lidgerwood Mfg. Co., New York
*Wood Hydr. Hoist & Body Co., Detroit, Mich.
Rock Mfg. Co., Waterloo, N. Y.
Van Dorn Iron Wks., Cleveland, O.

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Dee Co., Wm. E., Chicago, Ill.
Dickey Clay Mfg. Co., W. S., Kansas City, Mo.
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Metropolitan Paving Brick Co., Canton, Ohio.
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- Ransome Concrete Mch'y. Co., Dunellen, N. J.

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- Ingersoll-Rand Co., New York.
- Mulcoy Co., Inc., Phila., Pa.
- Penna Flexible Metallic Tubing Co., Phila., Pa.
- Republic Rubber Co., Youngstown, O.
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- Darling Valve & Mfg. Co., Williamsport, Pa.
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- Iowa Valve Co., Oskaloosa, Ia.
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- Rensselaer Valve Co., Troy, N. Y.
- Smith Mfg. Co., A. P., East Orange, N. J.
- Wood & Co., R. D., Philadelphia, Pa.

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- Rumsey Pump Co., Seneca Falls, N. Y.
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- Baker Ice Machine Co., Omaha, Neb.
- Brunswick-Kroeschell Co., New Brunswick, N. J.
- Carbondale Machine Co., Carbondale, Pa.
- De La Vergne Machine Co., New York.
- Frick Co., Inc., Waynesboro, Pa.
- Triumph Ice Machine Co., Cincinnati, O.
- United Iron Works, Inc., Kansas City, Mo.
- Vilter Mfg. Co., Milwaukee, Wis.
- Vogt Mach. Co., Henry, Louisville, Ky.
- York Mfg. Co., York, Pa.

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- Gulick-Henderson Co., New York.
- Hunt & Co., Robert W., Chicago, Ill.
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- Standard Testing Laboratories, Inc., New York.

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- (See Expansion Joint Material)

JOINTS, FLEXIBLE PIPE. (See Flexible Joints.)

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- *Spears-Wells Mach'y Co., Oakland, Cal.
- *Universal Road Machinery Co., Kingston, N. Y.
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- Macleod Co., Cincinnati, Ohio.
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- Tarrant Mfg. Co., Saratoga Springs, N. Y.
- Union Iron Wks., Hoboken, N. J.

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- Star Headlight & Lanterna Co., Rochester, N. Y.

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- Youngstown Pressed Steel Co., Warren, O.

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- Jacobsen Mfg. Co., Racine, Wis.
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- Philadelphia Lawn Mower Co., Philadelphia, Pa.
- Townsend Co., S. P., Bloomfield, N. J.
- Western Implement Co., Port Washington, Wis.
- Worthington Mower Co., Stroudsburg, Pa.

LEADITE

- Leadite Co., The, Philadelphia, Pa.

LEAD-MELTING FURNACES

- *Aeroll Burner Co., Union Hill, N. J.
- *Littlefield Bros., Cincinnati, O.
- Canton Fdry. & Machy. Co., Canton, O.
- Chicago Flexible Shaft Co., Chicago, Ill.
- Foch's Sons, Geo., Hoboken, N. J.
- Hauke Mfg. Co., Brooklyn, N. Y.
- Smith Mfg. Co., A. P., E. Orange, N. J.

LETTERING GUIDES

- Wood-Regan Instrument Co., Niagara Falls, N. Y.

LETTERS AND FIGURES, METAL

- Niagara Metal Stamp Corp., Niagara Falls, N. Y.

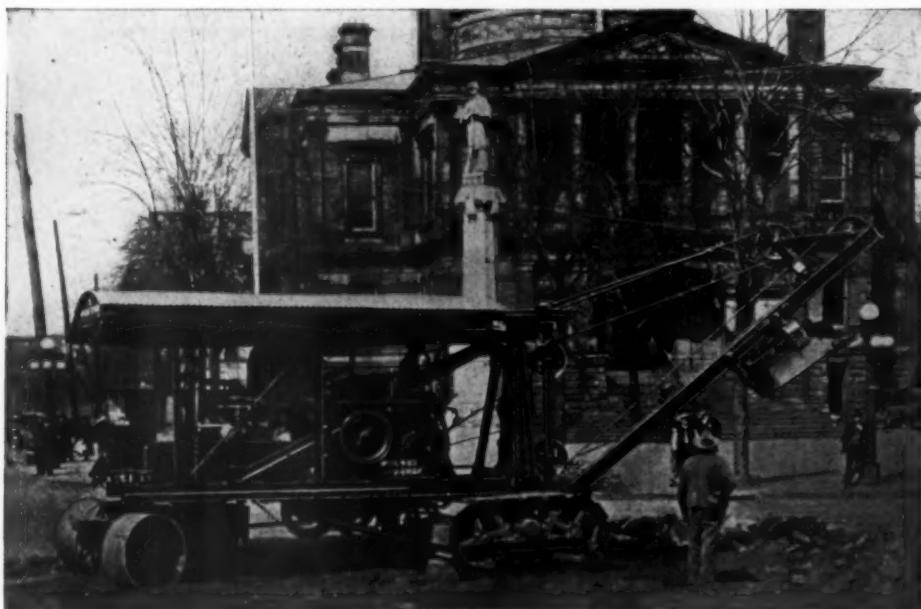
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- *Milburn Co., Alex., Baltimore, Md.
- Carbie Mfg. Co., Duluth, Minn.
- General Electric Co., Schenectady, N. Y.
- Hauke Mfg. Co., Brooklyn, N. Y.
- Macleod Co., Cincinnati, O.
- Prest-O-Lite Co., Inc., New York.

LIGHTING STANDARDS. (See Street Lamp Posts)

* Indicates that the manufacturer carries an advertisement. See index facing inside back cover.*

STEAM - GAS - OR ELECTRIC DRIVE



Keystone 4 Gas Crawler

HERE in front of the Courthouse in the town of New Philadelphia, Ohio, Shop Number 4928 with its paint untarnished, pauses proudly to have its likeness taken.

Heartfelt thanks from the advertising manager to Leroy Springer, the Contractor, for posing his pet before the Courthouse and not in front of a junk yard. We are not fussy; but after all,

background is important—to men or machines.

The Keystone Skimmer (fully patented, good friends) is here lifting old pavement preparatory to resurfacing. This is a typical Keystone job. No other machine or implement is so well adapted for the purpose.

Many of your excavation problems are worked out in the Keystone Shovel Catalog. Send for it.



KEYSTONE DRILLER COMPANY, BEAVER FALLS, PENNSYLVANIA
178 BROADWAY, N. Y. MONADNOCK BLOCK, CHICAGO JOPLIN, MO.

KEYSTONE SHOVEL

9-D-32

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Where to Purchase

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LIQUID CHLORINE

- *Arnold, Hoffman & Co., Inc., New York.
- Electro Bleaching Gas Co., New York.
- Hooker Electrochemical Co., New York.
- Mathieson Alkali Works, Inc., New York.
- Penna. Salt Mfg. Co., Philadelphia, Pa.
- LOADERS, GRAVEL, WAGON, CAR, ETC.**
- *Atlas Engineering Co., Milwaukee, Wis.
- *Barber-Green Co., Aurora, Ill.
- *Bay City Dredge Works, Bay City, Mich.
- *Hals Mfg. Co., Geo., New York.
- *Industrial Plants Corp., Toledo, O.
- *Russell Grader Mfg. Co., Minneapolis, Minn.
- Sauerman Bros., Chicago, Ill.
- *Smith Co., T. L., Milwaukee, Wis.
- *Spears-Well Mach'y Co., Oakland, Cal.
- *Universal Road Machinery Co., Kingston, N. Y.
- Austin Machinery Corp'n, Muskegon, Mich.
- Bonney Supply Co., Inc., Rochester, N. Y.
- Brown Hoisting Machy. Co., Cleveland, O.
- Chain Belt Co., Milwaukee, Wis.
- Conant Machine Co., Concord Junction, Mass.
- Fairfield Engineering Co., Marion, Ohio
- Gifford-Wood Co., Hudson, N. Y.
- Green, L. P., Chicago, Ill.
- Jeffrey Mfg. Co., Columbus, O.
- Lee Varrow & Body Co., Chicago, Ill.
- Link-Belt Co., Chicago, Ill.
- Nelson Iron Wks., Brooklyn, N. Y.
- Portable Machy. Co., Passaic, N. J.
- Sackett Screen & Chute Co., H. B., Chicago, Ill.
- Specialty Eng. Co., Philadelphia, Pa.
- Weller Mfg. Co., Chicago, Ill.

LOCK BAR STEEL PIPE

- East Jersey Pipe Co., New York.

LOCKERS, STEEL

- Durand Steel Locker Co., Chicago, Ill.
- Hart & Hutchinson Co., New Britain, Conn.
- Lyon Metallic Mfg. Co., Aurora, Ill.
- Medart Mfg. Co., Fred., St. Louis, Mo.

LOCOMOTIVES, FOR CONTRACTORS, ETC.

- *Vulcan Iron Works, Wilkes-Barre, Pa.
- *Whitcomb Co., Geo. D., Rochelle, Ill.
- Adamson Motor Co., Birmingham, Ala.
- American Locomotive Co., New York.
- Baldwin Locomotive Works, The Phila., Pa.
- Brookville Track & Tractor Co., Brookville, Pa.
- Davenport Locomotive Works, Davenport, Ia.
- Fate-Roof-Heath Co., Plymouth, O.
- Lima Locomotive Wks., Lima, O.
- Industrial Equipment Co., Inc., Minster, O.
- Milwaukee Locomotive Mfg. Co., Milwaukee, Wis.
- Plymouth Locomotive Works, Plymouth, O.
- Porter Co., H. K., Pittsburgh, Pa.
- Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

LUBRICATORS

- *McCord Radiator Mfg. Co., Detroit, Mich.

LUMBER, HEAVY CONSTRUCTION

- Brown Co., Portland, Me.
- Crowell & Spencer Lumber Co., Long Leaf, La.
- Exchange Sawmills Sales Co., Kansas City, Mo.
- Great Southern Lumber Co., Bogalusa, La.
- Industrial Lumber Co., Elizabeth, La.
- Long Bell Lumber Co., Kansas City, Mo.
- Sargent Lumber Co., Little Rock, Ark.
- Stern Co., Inc., E. J., New York.
- Weyerhaeuser Sales Co., Spokane, Wash.

LUMBER, STEEL

- *Truscon Steel Co., Detroit, Mich.
- Berger Mfg. Co., Canton, O.
- General Fireproofing Co., Youngstown, O.

MANHOLE COVERS. (See "Castings, Street")

METAL LATH. (See "Lath")

METAL ROOFING (See "Roofing")

METER BOXES

- *Ford Meter Box Co., Wabash, Ind.
- Clark Co., H. W., Mattoon, Ill.
- Clow & Sons, J. B., Chicago, Ill.
- Columbian Iron Works, Chattanooga, Tenn.
- Mueller Company, Decatur, Ill.

METER COUPLINGS

- *Ford Meter Box Co., Wabash, Ind.
- *Neptune Meter Co., New York.
- *Pittsburgh Meter Co., Pittsburgh, Pa.
- *Union Water Meter Co., Worcester, Mass.
- Clark Co., H. W., Mattoon, Ill.
- Mueller Company, Decatur, Ill.

METER TESTERS

- *Ford Meter Box Co., Wabash, Ind.
- *Neptune Meter Co., New York.
- *Pittsburgh Meter Co., Pittsburgh, Pa.
- Clark Co., H. W., Mattoon, Ill.
- Mueller Co., Decatur, Ill.
- National Meter Co., New York.

METERS, ELECTRIC (WATTHOUR)

- Duncan Elec. Mfg. Co., LaFayette, Ind.
- General Electric Co., Schenectady, N. Y.
- Sangamo Electric Co., Springfield, Ill.
- Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

METERS, GAS

- *Pittsburgh Meter Co., Pittsburgh, Pa.
- American Meter Co., New York.
- Bailey Meter Co., Cleveland, O.
- Builders Iron Fdry., Providence, R. I.
- Cleveland Gas Meter Co., Cleveland, O.

METERS, WATER, OIL AND GASOLINE

- *Badger Meter Mfg. Co., Milwaukee, Wis.
- *Neptune Meter Co., New York.
- *Pittsburgh Meter Co., Pittsburgh, Pa.
- *Union Water Meter Co., Worcester, Mass.
- Buffalo Meter Co., Buffalo, N. Y.
- Federal Meter Co., Brooklyn, N. Y.
- Gamon Meter Co., Newark, N. J.
- Hersey Mfg. Co., Boston, Mass.
- National Meter Co., New York.
- Thomson Meter Co., Brooklyn, N. Y.
- Worthington Pump & Maby. Corp., New York.

METERS, WATER (VENTURI TYPE)

- Builders Iron Foundry, Providence, R. I.
- Simplex Valve & Meter Co., Philadelphia, Pa.

MIXERS, CONCRETE (See Concrete Mixers)

MIXERS, GROUT

- *American Cement Machy. Co., Inc., Keokuk, Ia.
- *Lakewood Engineering Co., Cleveland, O.
- Kent Machine Co., Kent, O.
- Union Iron Works, Inc., Hoboken, N. J.

MIXERS, HOT

- *Barber Asphalt Co., Philadelphia, Pa.
- *Koehring Co., Milwaukee, Wis.
- Austin Machinery Corp'n, Muskegon, Mich.

MIXERS, MORTAR

- *American Cement Machy. Co., Inc., Keokuk, Ia.
- *Blaw-Knox Co., Pittsburgh, Pa.
- *Construction Machinery Co., Waterloo, Ia.
- *Lakewood Engineering Co., Cleveland, O.
- *Lansing Co., Lansing, Mich.
- *Marshall-Capron Co., Chicago, Ill.
- *Smith Co., T. L., Milwaukee, Wis.
- Anchor Mfg. Co., Chicago, Ill.
- Austin Machinery Corp'n, Muskegon, Mich.
- C. H. & E. Manufacturing Co., Milwaukee, Wis.
- Kent Machine Co., Kent, O.
- Knickerbocker Co., Jackson, Mich.
- Ransome Concrete Machy. Co., Dunellen, N. J.

MOTORCYCLES

- Cleveland Motorcycle Co., Cleveland, Ohio.
- Excelsior Motor Mfg. & Supply Co., Chicago, Ill.
- Harley-Davidson Motor Co., Milwaukee, Wis.
- Indian Motorcycle Co., Springfield, Mass.

MOTORS, ELECTRIC (See Electric Generators and Motors)

MOTORS, GASOLINE

- *Climax Engineering Co., Clinton, Iowa
- *Continental Motors Corp., Detroit, Mich.
- *Hinckley Motors, Inc., Detroit, Mich.
- Beaver Mfg. Co., Milwaukee, Wis.
- Buda Co., Harvey, Ill.
- Cushman Motor Wks., Lincoln, Neb.
- Le Roil Co., Milwaukee, Wis.
- Waukesha Motor Co., Waukesha, Wis.
- Wisconsin Motor Mfg. Co., Milwaukee, Wis.

MOTOR TRUCKS

- *Ford Motor Co., Detroit, Mich.
- *General Motors Truck Co., Pontiac, Mich.
- *International Motor Co., New York.
- *United Motor Products Co., Grand Rapids, Mich.
- Acme Motor Truck Co., Cadillac, Mich.
- Atterbury Motor Car Co., Buffalo, N. Y.
- Autocar Co., Ardmore, Pa.
- Bessamer Motor Truck Co., Grove City, Pa.
- Brockway Motor Truck Co., Cortland, N. Y.

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This Watch Belonged to a Contractor

IT had been given to him by his wife to commemorate their twelfth wedding anniversary. But it was a good watch just the same.

The contractor used it to find out when it was dinner time, when it was starting time and when it was quitting time. But he never used it to find out why he wasn't making the profits he should.

One day

while watching one of his pavers, he did. He noted that the paver skip lay flat on the ground, waiting for materials, for exactly three minutes and seventeen seconds.

During the next fifteen minutes things hummed along in beautiful fashion. Then came a five minute and twelve second wait. Then eleven minutes of work. Then another wait for four minutes and fifty seconds.

So the Contractor

did some figuring on the back of a blue print. And he used language that wouldn't bear repetition at a revival meeting.

But you can't blame him. Seventeen minutes and four seconds had been wasted by his paver in less than an hour. And that means more than ten lineal feet of pavement lost.

Two Barber-Greene working in a tight corner on Market Street, Chicago. Their ability to show real loading and batching speed on practically every and any job is one reason why they are turning in big profits for contractors all over the country.

The latest Barber-Greene road book—*Contracting with Barber-Greene*, shows what contractors are doing on material handling. Send for a copy. It's free to contractors.

So he jumped into his car and tore back to the batching plant. The reason for the lost time was plain. The batch trucks were bunching while waiting to be loaded. That called for more figures on the back of the blue print. This time they had to do with the cost of a lot of fancy loading equipment.

That night

the contractor went home and read an ad and wrote an ad. The one he read was like this one. The one he wrote simply said, "For Sale, slightly used, etc." He answered the one he read. Someone else answered the one he wrote.

A Barber-Greene now loads and batches his gravel. Another loads and batches his sand. Incidentally a Barber-Greene conveyor piles cement in his cement shed.

This contractor

is going to California this winter. He's taking his watch with him. That's only fair. In addition to telling him when it is dinner time it brought in the Barber-Greene that made the paver do a day's work. And a season of those days built up the bank balance that made the trip to California possible.



BARBER-GREENE CO. 485 W. Park Av., Aurora, Ill.

Representatives

in Fifty Cities

BARBER-GREENE
Portable Belt Conveyors
Coal Loaders Automatic Ditch Diggers Coal Feeders

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Where to Purchase

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Clydesdale Motor Truck Co., Clyde, O.
 Diamond T. Motor Car Co., Chicago, Ill.
 Federal Motor Truck Co., Detroit, Mich.
 Four Wheel Drive Auto Co., Clintonville, Wis.
 Garford Motor Truck Co., Lima, O.
 Gramm Bernstein Truck Corp'n., Lima, O.
 Gramm & Kincaid Motors, Inc., Lima, Ohio
 The Hug Co., Highland, Ill.
 Indiana Truck Corp'n., Marion, Ind.
 International Harvester Co., Chicago, Ill.
 Kolly Springfield Motor Truck Co., Springfield, O.
 Kinsel Motor Car Co., Hartford, Wis.
 Larabee-Deyo Motor Tr. Co., Binghamton, N. Y.
 Pierce-Arrow Motor Car Co., Buffalo, N. Y.
 Republic Motor Truck Co., Alma, Mich.
 Ruggles Motor Truck Co., Saginaw, Mich.
 Service Motor Truck Co., Wabash, Ind.
 Standard Motor Truck Co., Detroit, Mich.
 Sterling Motor Truck Co., Milwaukee, Wis.
 Stewart Motor Corp'n., Buffalo, N. Y.
 Traffic Motor Truck Co., St. Louis, Mo.
 U. S. Motor Truck Co., Cincinnati, O.
 White Co., Cleveland, Ohio.

MOULDS, CONCRETE

*Blaw Knox Co., Pittsburgh, Pa.
 *Raber & Lang Mfg. Co., Kendallville, Ind.

MUCKING MACHINES

Hoar Shovel Co., Duluth, Minn.

NUMBERS, HOUSE (See "House Numbers")

OAKUM

Wall Rope Works, Beverly, N. J.

OIL BURNERS

*Aeroil Burner Co., Union Hill, N. J.
 Hauck Mfg. Co., Brooklyn, N. Y.

OILS, ROAD

*Barber Asphalt Co., Philadelphia, Pa.
 *Barrett Co., New York.
 *Standard Oil Co., (Indiana), Chicago, Ill.
 *Texas Company, New York.
 Atlantic Refining & Asphalt Corp'n., Philadelphia
 Headley Good Roads Co., Philadelphia, Pa.
 Pioneer Asphalt Co., Lawrenceville, Ill.
 Standard Oil Co., (Ia.), New Orleans, La.
 Standard Oil Co., (N. J.), Newark, N. J.
 Standard Oil Co., (N. Y.), New York.

OXY-ACETYLENE APPARATUS

Oxweld Acetylene Co., Newark, N. J.

OXYGEN

Linde Air Products Co., New York.

PACKING, WATER PIPE

*Union Water Meter Co., Worcester, Mass.
 Leadite Co., The, Philadelphia, Pa.
 United Lead Company, New York.

PAINT GUNS

Spray Painting & Finishing Equipment Sales Co.,
 Boston, Mass.

PAINTS, METAL PROTECTION

*Barber Asphalt Co., Philadelphia, Pa.
 *Barrett Co., New York.
 *Carey Co., Phillip, Cincinnati, Ohio.
 *Dixon Crucible Co., Joe, Jersey City, N. J.
 *Solvay Process Co., New York
 Acme White Ld. & Col. Works, Detroit, Mich.
 Berry Bros., Detroit, Mich.
 Cook Paint & Varnish Co., Kansas City, Mo.
 Detroit Graphite Co., Detroit, Mich.
 Detroit White Lead Wks., Detroit, Mich.
 Du Pont de Nemours & Co., Inc., E. I., Wilming-
 ton, Del.
 Minwax Co., New York.
 Protekol Corp., New York.
 Ruberoid Co., New York.
 Sherwin-Williams Co., Cleveland, O.
 Sonnenberg Sons, Inc., L., New York.
 Toch Bros., New York.
 Tropical Paint & Oil Co., Cleveland, Ohio.
 Truscon Laboratories, Detroit, Mich.

PAPERS, BLUE PRINT AND BROWN PRINT

Indianapolis Blue Print & Supply Co., Indian-
 apolis, Ind.

PAPER BUILDING, ROOFING, ETC.

*Barber Asphalt Co., Philadelphia, Pa.
 *Barrett Co., New York.

*Carey Co., Phillip, Cincinnati, Ohio.

Bird & Son, Inc., E. Walpole, Mass.
 Brown Co., Portland, Me.
 Hydrex Asphalt Products Corp., New York.
 Johns-Manville, Inc., New York.
 National Roofing Co., Tonawanda, N. Y.
 Ruberoid Co., New York.

PARK BENCHES

*Stewart Iron Works Co., Cincinnati, O.
 Art Concrete Works, Pasadena, Calif.
 Bausman Mfg. Co., Millersville, Pa.
 Dow Co., Louisville, Ky.
 Meyers Mfg. Co., Fred J., Hamilton, Ohio.
 Mott Iron Wks., J. L., New York.

PAVING AND ROAD ROLLERS. (See Road and Paving Rollers)

PAVING BLOCKS, GREASOTED WOOD. (See "Greased Blocks")

PAVING BRICK

Albion Shale Brick Co., Albion, Ill.
 Alton Brick Co., Alton, Ill.
 Binghamton Brick Co., Binghamton, N. Y.
 Buckeye Shale Brick Co., Cleveland, Ohio.
 Buffalo Brick Co., Buffalo, Kans.
 Burton Townsend Co., Zanesville, N. Y.
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 Cleveland Brick & Clay Co., Cleveland, O.
 Clydesdale Brick & Stone Co., Pittsburgh, Pa.
 Coffeyville Vit. Brick & Tile Co., Coffeyville, Kans.
 Collinwood Shale Brick Co., Cleveland, O.
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 Denny Renton Clay & Coal Co., Seattle, Wash.
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 Francis Vit. Brick Co., Boynton, Okla.
 Georgia Vitrified Brick Co., Augusta, Ga.
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 Hocking Valley Brick Co., Columbus, O.
 Independence Pav. Br. Co., Independence, Kans.
 Layton Fire Clay Co., McKeesport, Pa.
 McAvoy Vit. Brick Co., Philadelphia, Pa.
 Martinsville Brick Co., Martinsville, Ind.
 Mayer Brick Co., C. P., Bridgeville, Pa.
 Metropolis Paving Brick Co., Pittsburgh, Kans.
 Metropolitan Paving Brick Co., Canton, O.
 Mineral Wells Pav. Brick Co., Mineral Wells, Tx.
 Moberly Paving Brick Co., Moberly, Mo.
 Murphysboro Paving Brick Co., Murphysboro, Ill.
 Nelsonville Brick Co., Nelsonville, O.
 Patton Clay Mfg. Co., Patton, Pa.
 Paxton Brick Co., Watsontown, Pa.
 Peebles Paving Brick Co., Portsmouth, O.
 Penna. Clay Co., Pittsburgh, Pa.
 Pittsburgh Paving Brick Co., Pittsburgh, Kans.
 Purington Paving Brick Co., Galesburg, Ill.
 Russell Clay Mfg. Co., Alton, Ala.
 Southern Clay Mfg. Co., Chattanooga, Tenn.
 Springfield Paving Brick Co., Springfield, Ill.
 Sterling Brick Co., Olean, N. Y.
 Streator Clay Mfg. Co., Streator, Ill.
 Terre Haute Vit. Brick Co., Terre Haute, Ind.
 Thornton Fire Brick Co., Clarksville, W. Va.
 Thurber Brick Co., Thurber, Texas.
 Toronto Fire Clay Co., Toronto, Ohio.
 Trinidad Brick & Tile Co., Trinidad, Ohio.
 Veedersburg Paver Co., Veedersburg, Ind.
 Western Shale Products Co., Fort Scott, Kans.
 Westport Paving Brick Co., Westport, Md.

PAVING MACHINERY. (See Road and Paving Machinery)

PAVING GUARDS, STEEL

*Godwin Co., W. S., Baltimore, Md.

PAVING MATERIALS. (See "Asphalt," "Paving Brick," "Granite Block," etc.)

PAVING MIXERS. (See Concrete Mixers)

PAVING TOOLS

*Aeroil Burner Co., Union Hill, N. J.
 *Barber Asphalt Co., Philadelphia, Pa.
 *Connery & Co., Inc., Philadelphia, Pa.
 *Littleford Bros. Co., Cincinnati, O.
 *Warren Bros. Co., Boston, Mass.
 Anderson Tool & Sup. Co., W. H., Detroit, Mich.
 Cummer & Sons Co., F. D., Cleveland, O.
 Union Iron Works, Hoboken, N. J.

* Indicates that the manufacturer carries an advertisement. See index facing inside back cover.*

Endurance

NURMI and the NEWPORT Both Breaking Records of ENDURANCE

The triumphs of Nurmi, the wonderful Finnish Runner, in breaking all track records, are the admiration of every true American Sportsman.

The Newport Culvert has the same capacity to endure under prolonged stress without succumbing; the power to bear and continue, in spite of destructive forces; the "Holding on" under severe strain or exposure. This is what you get with our Genuine Open Hearth Iron Culverts—guaranteed to be 99.875% Pure Iron Copper Alloy.

The distinct advantages of a Corrugated Metal Culvert Pipe are its Rust Resisting qualities, and the fact that the corrugations give remarkable strength for the weight of the metal.

Made in all sizes, and in multiples of two feet to meet all requirements. Coated with not less than two ounces of spelter per sq. ft. of exposed surface. Acceptable on all Federal Aid Roads where the U. S. Department of Public Roads' specifications govern metal culvert pipe. Furnished in round and half round types to best suit your needs.

For descriptive literature and further data apply to



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Where to Purchase

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PERFORATED METALS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hendrick Mfg. Co., Carbondale, Pa.

PICKS

Beall Tool Co., East Alton, Ill.
Hubbard Co., Pittsburgh, Pa.
Iron City Tool Works, Pittsburgh, Pa.
Klein-Logan Co., Pittsburgh, Pa.
Verona Tool Works, Verona, Pa.
Warren Tool & Forge Co., Warren, O.
Warwood Tool Co., Wheeling, W. Va.
Wyoming Shovel Wks., Wyoming, Pa.

PILE DRIVERS

*Clyde Iron Works Sales Co., Duluth, Minn.
*Lidgerwood Manufacturing Co., New York
*McKiernan-Terry Drill Co., New York
*Mead-Morrison Mfg. Co., E. Boston, Mass.
Browning Co., Cleveland, O.
Industrial Works, Bay City, Mich.
McMyler Interstate Co., Cleveland, O.
Union Iron Works, Hoboken, N. J.

PILE HAMMERS, STEAM

*Clyde Iron Works Sales Co., Duluth, Minn.
*McKiernan-Terry Drill Co., New York
Industrial Works, Bay City, Mich.
National Hoisting Eng. Co., Harrison, N. J.
Union Iron Works, Hoboken, N. J.
Vulcan Iron Works, Chicago, Ill.

PILELING, CONCRETE

MacArthur Concrete Pile & Foundation Co., N. Y.
Raymond Concrete Pile Co., New York

PILELING, INTERLOCKING STEEL

Bethlehem Steel Co., Bethlehem, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Jones & Laughlin Steel Co., Pittsburgh, Pa.

PIPE, CAST IRON

*Central Foundry Co., New York.
*National Cast Iron Pipe Co., Birmingham, Ala.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
American Cast Iron Pipe Co., Birmingham, Ala.
Clow & Sons, J. B., Chicago, Ill.
Donaldson Iron Co., Elkhorn, Pa.
Fox & Co., John, New York.
Glamorgan Pipe & Fdry. Co., Lynchburg, Va.
Lynchburg Foundry Co., Lynchburg, Va.
Warren Fdry. & Machine Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

PIPE, CULVERT. (See Culverts)

PIPE, LEAD

United Lead Company, New York.

PIPE, REINFORCED CONCRETE

*Newark Concrete Pipe Co., Newark, N. J.
Concrete Products Co., Pittsburgh, Pa.
Core Joint Concrete Pipe Co., Baltimore, Md.
Independent Concrete Pipe Co., Indianapolis, Ind.
Lock Joint Pipe Co., E. Orange, N. J.
Massey Concrete Products Corp'n., Chicago, Ill.

PIPE, RIVETED STEEL OR IRON

*Blaw-Knox Co., Pittsburgh, Pa.
Connery & Co., Inc., Philadelphia, Pa.
*Littleford Bros., Cincinnati, Ohio.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.
Canton Culvert & Pipe Co., Canton, O.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
East Jersey Pipe Co., New York.
Hammond Iron Works, Warren, Pa.
Hardisty Mfg. Co., R., Denver, Colo.
Honhorst Co., Jas., Cincinnati, Ohio.
Lancaster Iron Works, Lancaster, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Tippett & Wood, Phillipsburg, N. J.
Welter Mfg. Co., Chicago, Ill.

PIPE, SPIRAL RIVETED

Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.

PIPE, STEEL

Central Tube Co., Pittsburgh, Pa.
East Jersey Pipe Co., New York.
Jones & Laughlin Steel Co., Pittsburgh, Pa.

National Tube Co., Pittsburgh, Pa.
Republic Iron & Steel Co., Youngstown, O.
Span-Charlton & Co., Pittsburgh, Pa.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, O.

PIPE, WOOD

American Wood Pipe Co., Tacoma, Wash.
Continental Pipe Mfg. Co., Seattle, Wash.
Michigan Pipe Co., Bay City, Mich.
Pacific Tank & Pipe Co., San Francisco, Cal.
Redwood Mfrs. Co., San Francisco, Cal.
Standard Wood Pipe Co., Williamsport, Pa.
Wyckoff & Sons Co., A., Elmira, N. Y.

PIPE, WROUGHT IRON

Byers Co., A. M., Pittsburgh, Pa.
Reading Iron Co., Reading, Pa.

PIPE BENDING MACHINES

Amer. Pipe Bending Mach. Co., Boston, Mass.
Walworth Mfg. Co., Boston, Mass.

PIPE COVERING

AIRCELL

*Carey Co., Philip, Cincinnati, Ohio.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Johns-Manville, Inc., New York.
Kearney & Mattison Co., Ambler, Pa.
Nat'l Asbestos Co., Jersey City, N. J.
Norristown Mag. & Asb. Co., Norristown, Pa.
Sall Mt. Co., Chicago, Ill.
Watson Co., H. F., Erie, Pa.

85 PER CENT MAGNESIA

*Carey Co., Philip, Cincinnati, Ohio.
Ehret Magnesia Co., Valley Forge, Pa.
Johns-Manville, Inc., New York.
Kearney & Mattison Co., Ambler, Pa.

WOOD

Continental Pipe Mfg. Co., Seattle, Wash.
Redwood Mfrs. Co., San Francisco, Cal.
Ric-Wil Co., Cleveland, O.
Wyckoff & Son Co., A., Elmira, N. Y.

PIPE CUTTERS. (See Cutters, Pipe, Hand.)

PIPE FITTINGS

*Central Foundry Co., New York.
*Nat'l Cast Iron Pipe Co., Birmingham, Ala.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
American G. I. Pipe Co., Birmingham, Ala.
Builders Iron Fdry., Providence, R. I.
Clow & Sons, J. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Reading Steel Casting Co., Inc., Bridgeport, Conn.
Warren Fdry. & Mach. Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

PIPE HANDLING MACHINERY

Mueller Company, Decatur, Ill.
Taylor Portable Steel Derrick Co., Chicago, Ill.

PIPE JOINT COMPOUND. (Sewer)

*Carey Co., Philip, Cincinnati, Ohio.
*Pacific Flush Tank Co., Chicago and New York
G. K. Sales Co., Macungie, Pa.
Leadite Company, Inc., Philadelphia, Pa.
Ruberoil Co., New York.
Waring-Underwood Co., Philadelphia, Pa.

PIPE JOINT MATERIAL. (Cast Iron)

Lead-Hydro-Tite Co., Boston, Mass.
Leadite Co., The, Philadelphia, Pa.
United Lead Co., New York.

PLAYGROUND APPARATUS

American Playground Device Co., Anderson, Ind.
Chicago Gymnasium Equip. Co., Chicago, Ill.
Everwear Mfg. Co., Springfield, O.
George, Howard, Philadelphia, Pa.
Hill-Standard Co., Anderson, Ind.
Medart Mfg. Co., Fred. St. Louis, Mo.
Mitchell Mfg. Co., Milwaukee, Wis.
Patterson-Williams Co., San Jose, Calif.
Spalding & Bros., A. G., Chicopee, Mass.
Zieg Mfg. Co., F. B., Fredericktown, Ohio

PLOWS, CONTRACTORS

*Austin Western Rd. Mach. Co., Chicago, Ill.
*Burch Plow Works Co., Crestline, O.
*Caterpillar Tractor Co., San Leandro, Calif.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Adams & Co., J. D., Indianapolis, Ind.

* Indicates that the manufacturer carries an advertisement. See index facing inside back cover.*



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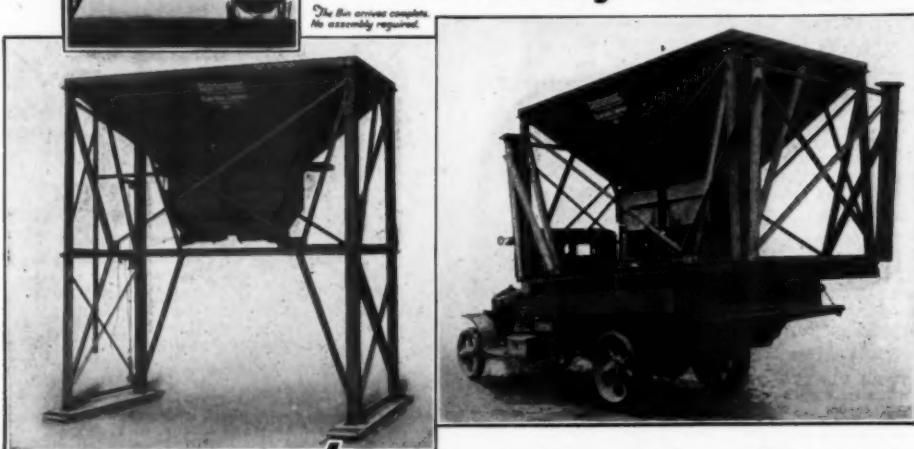
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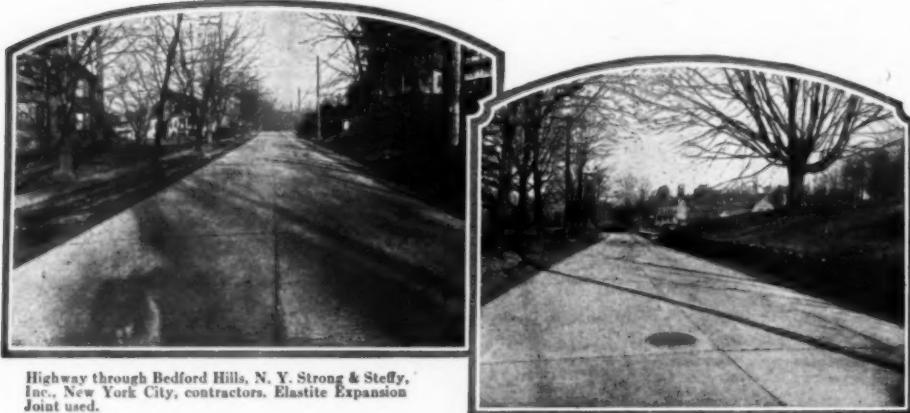
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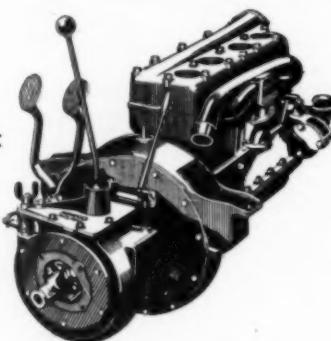
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 - *Good Roads Mach'y Co., Kennett Square, Pa.
 - *Haisl Mfg. Co., New York.
 - *Littleford Bros., Cincinnati, O.
 - *Russell Grader Mfg. Co., Minneapolis, Minn.
 - *Universal Road Machinery Co., Kingston, N. Y.
 - *Wickwire Spencer Steel Corp., New York.
 - Allis-Chalmers Mfg. Co., Milwaukee, Wis.
 - Austin Mfg. Co., Chicago, Ill.
 - Brown Hoisting Mach'y Co., Cleveland, O.
 - O. O. Bartlett & Snow Co., Cleveland, Ohio.
 - Case Threshing Machine Co., J. L., Racine, Wis.
 - Chain Belt Co., Milwaukee, Wis.
 - Galion Iron Wks. & Mfg. Co., Galion, Ohio.
 - Gifford-Wood Co., Hudson, N. Y.
 - Green, L. P., Chicago, Ill.
 - Hendrick Mfg. Co., Carbondale, Pa.
 - Jeffrey Mfg. Co., Columbus, O.
 - Link-Belt Co., Chicago, Ill.
 - Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
 - Newaygo Eng. Co., Newaygo, Mich.
 - New Jersey Wire Cloth Co., Trenton, N. J.
 - Robins Conv. Belt Co., New York.
 - Sackett Screen & Chute Co., H. B., Chicago, Ill.
 - Webster Mfg. Co., Chicago, Ill.
 - Weller Mfg. Co., Chicago, Ill.
- SCREENS, SEWAGE**
- Green Bay Fdry. & Mach Wks., Green Bay, Wis.
 - Link-Belt Co., Philadelphia, Pa.
 - Sanitation Corp'n, New York.
 - Simplex Ejector Co., Chicago, Ill.
- SEWAGE DISPOSAL APPARATUS**
- *Pacific Flush Tank Co., Chicago and New York.
 - Dorr Co., New York.
 - Sanitation Corp'n, New York.
 - Simplex Ejector Co., Chicago, Ill.
- SEWAGE PUMPS (See "Pumps, Sewage")**
- SEWAGE EJECTORS**
- *Pacific Flush Tank Co., Chicago and New York.
 - Sanitation Corp'n, New York
 - Simplex Ejector Co., Chicago, Ill.
 - Yeomans Bros. Co., Chicago, Ill.
- SEWER BLOCKS, SEGMENT**
- American Vit. Products Co., Akron, O.
 - Cannelton Sewer Pipe Co., Cannelton, Ind.
 - Denver Sewer Pipe & Clay Co., Denver, Col.
 - Evens & Howard Fire Brick Co., St. Louis, Mo.
 - Dickey Clay Mfg. Co., W. S., Kansas City, Mo.
 - Laclede Clay Products Co., St. Louis, Mo.
 - Macomb Sewer Pipe Wks., Macomb, Ill.
 - Pacific Clay Products Co., Los Angeles, Cal.
 - Red Wing Sewer Pipe Co., Red Wing, Minn.
 - Robinson Clay Products Co., Akron, O.
 - Standard Fire Brick & Sewer Pipe Co., Pueblo, Colo.
- SEWER CLEANING APPARATUS**
- Champion Corporation, Hammond, Ind.
 - Self Propelling Nozzle Co., New York.
 - Turbine Sewer Machine Co., Milwaukee, Wis.
- SEWER PIPE AND DRAIN TILE**
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 - Blackner & Post Pipe Co., St. Louis, Mo.
 - Dee Co., Wm. E., Chicago, Ill.
 - Delaware Clay Products Co., Pittsburgh, Pa.
 - Dickey Clay Mfg. Co., W. S., Kansas City, Mo.
 - Denver Sewer Pipe & Clay Co., Denver, Col.
 - National Fireproofing Co., Pittsburgh, Pa.
 - Ohio Vitrified Pipe Co., Uhrichsville, O.
 - Robinson Clay Products Co., Akron, O.
- SEWER PIPE FORMS**
- Raber & Lang Mfg. Co., Kendallville, Ind.
 - Quinn Wire & Iron Works, Boone, Iowa
- SEWER RODS**
- Bissell Co., F., Toledo, O.
 - Champion Corporation, Hammond, Ind.
 - Healy, P. J., Jersey City, N. J.
 - Luck Sewer Equip. Co., Chicago, Ill.
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Berger Mfg. Co., Canton, Ohio.
 Canton Art Metal Co., Canton, Ohio.
 Edwards Mfg. Co., Cincinnati, Ohio.
 Eller Mfg. Co., Canton, Ohio.
 Milwaukee Corrugating Co., Milwaukee, Wis.
 Nat'l Sheet Metal Roofing Co., Jersey City, N. J.
 Newport Rolling Mill Co., Newport, Ky.
 Penn Metal Co., Boston, Mass.
 Klauber Mfg. Co., Dubuque, Ia.
 Tiffin Art Metal Co., Tiffin, Ohio.
 Wheeling Metal Mfg. Co., Wheeling, W. Va.

SHOERS

*Universal Form Clamp Co., Chicago, Ill.
 Dayton Sure Grip & Shore Co., Dayton, Ohio.
 The O. D. G. Co., Owensboro, Ky.
 Ross Co., H. W., Cincinnati, O.
 Roos-Meyer-Hecht Co., Cincinnati, O.
 Symons Clamp & Mfg. Co., Chicago, Ill.

SHOVELS, ELECTRIC

*Bay City Dredge Works, Bay City, Mich.

*Byers Machine Co., Ravenna, O.

*Koehring Co., Milwaukee, Wis.

*Osgood Co., Marion, Ohio.

*Tew Shovel Co., Lorain, O.

Bucyrus Co., South Milwaukee, Wis.

Marion Steam Shovel Co., Marion, O.

SHOVELS, GASOLINE

*Bay City Dredge Works, Bay City, Mich.

*Byers Machine Co., Ravenna, O.

*Harnischfeger Corp., Milwaukee, Wis.

*Koehring Co., Milwaukee, Wis.

*Osgood Co., Marion, Ohio.

*Tew Shovel Co., Lorain, O.

American Steel Dredge Co., Fort Wayne, Ind.

Austin Machinery Corp'n., Muskegon, Mich.

Brown Hoisting Mach'y Co., Cleveland, O.

Buycrus Co., So. Milwaukee, Wis.

Fairbanks Steam Shovel Co., Marion, O.

Marion Steam Shovel Co., Marion, O.

Orton & Steinbrenner Co., Chicago, Ill.

Speeder Mach'y Corp., Fairfield, Iowa.

SHOVELS, HAND

*Oliver Ames & Sons Corp., North Easton, Mass.
 *Ames Shovel & Tool Co., Boston, Mass.
 *Geo. Griffiths Co., Cheltenham, Pa.
 *The H. M. Myers Co., Beaver Falls, Pa.
 *T. Rowland's Sons, Inc., Cheltenham, Pa.
 *St. Louis Shovel Co. Plant, St. Louis, Mo.
 *Wright Shovel Co., Anderson, Ind.
 Beall Bros. Co., Alton, Ill.
 Conneaut Shovel Co., Conneaut, O.
 Hubbard & Co., Pittsburgh, Pa.
 Indiana Shovel Co., New Castle, Ind.
 Jackson Shovel Co., Montpelier, Ind.
 Pittsburgh Shovel Co., Pittsburgh, Pa.
 Russell Shovel Co., Aliquippa, Pa.
 Stevens-Webb Co., Inc., Altoona, Pa.
 Union Furnace Mfg. Co., Altoona, Pa.
 Wood Shovel & Tool Co., Piqua, Ohio.
 Wyoming Shovel Works, Wyoming, Pa.

SHOVELS, STEAM

*Byers Machine Co., Ravenna, Ohio.
 *Keystone Driller Co., Beaver Falls, Pa.
 *Osgood Co., The, Marion, O.
 *Tew Shovel Co., Lorain, O.
 Austin Machinery Corp'n., Muskegon, Mich.
 Bellwood Steam Shovel Co., Bellwood, Pa.
 Browning Co., Cleveland, O.
 Bucyrus Co., South Milwaukee, Wis.
 Erie Steam Shovel Co., Erie, Pa.
 Fairbanks Steam Shovel Co., Marion, O.
 Industrial Works, Bay City, Mich.
 Marion Steam Shovel Co., Marion, O.
 Orton & Steinbrenner Co., Chicago, Ill.

SIGNS, STREET AND ROAD

Auto Sign Display Co. of Mo., St. Louis, Mo.
 Automatic Signal & Sign Co., Chicago, Ill.
 Baltimore Enamel & Novelty Co., Baltimore, Md.
 Cavanagh Bros. & Co., New York.
 Elkhart Fdry. & Mach. Co., Elkhart, Ind.
 Evernu-Century Sign Co., Boston, Mass.
 Ingram-Richardson Mfg. Co., Beaver Falls, Pa.
 Lyle-Signs, Minneapolis, Minn.
 Municipal Street Sign Co., New York.
 Neike Sign Co., J. L., New York.
 Union Iron Products Co., East Chicago, Ind.
 Western Display & Mfg. Co., St. Paul, Minn.
SIGNS, TRAFFIC
 Acme Traffic Signal Co., Los Angeles, Cal.
 Adams & Westlake, Chicago, Ill.
 Auto Sign Display Co. of Mo., St. Louis, Mo.
 Automatic Signal & Sign Co., Chicago, Ill.

Automatic Signal & Sign Co., Canton, O.
 American Gas Accumulator Co., Elizabeth, N. J.

Crouse-Hinds Co., Syracuse, N. Y.

Elkhart Fdry. & Mach. Co., Elkhart, Ind.

Esco Mfg. Co., Peoria, Ill.

Evernu-Century Sign Co., Boston, Mass.

Griswold Safety Signal Co., Minneapolis, Minn.

Horni Signal Mfg. Corp., Newark, N. J.

King & Smith Co., Milwaukee, Wis.

Linn Material Co., So. Milwaukee, Wis.

Little Giant Co., Mankato, Minn.

Lyle-Signs, Minneapolis, Minn.

Ohio Traffic Devices Co., Columbus, O.

Tokheim Oil Tank & Pump Co., Fort Wayne, Ind.

Traffic Sign & Signal Co., Gloucester, Mass.

Traffic Signal Corp., New York.

Union Iron Products Co., E. Chicago, Ind.

SLATE, ROOFING

Vendor Slate Co., Inc., Easton, Pa.

SLATE, STRUCTURAL

Keenan Structural Slate Co., Bangor, Pa.

Penna. Structural Slate Co., Easton, Pa.

Phoenix Slate Co., Windgap, Pa.

Structural Slate Co., Pen Argyl, Pa.

SLEEVES, TAPPING AND VALVE

Mueller Company, Decatur, Ill.

Rensselaer Valve Co., Troy, N. Y.

Smith Mfg. Co., A. P., East Orange, N. J.

SLUICE GATES. (See Gates, Sluice)

SMOKE STACKS. (See Stacks, Steel)

SNOW CLEANING MACHINERY

*Austin-Western Road Machy. Co., Chicago, Ill.

*Barber Mfg. Co., Springfield, Ill.

*Barber-Greene Co., Aurora, Ill.

*Caterpillar Tractor Co., San Leandro, Calif.

*Good Roads Mach. Co., Kennett Square, Pa.

*Mack Trucks, Inc., New York.

*Mead-Morrison Mfg. Co., East Boston, Mass.

*Monarch Tractors, Inc., Watertown, Wis.

*Shaw-Eecho Tractor Co., Minneapolis, Minn.

Cleveland Tractor Co., Cleveland, Ohio.

Toy Co., W. M., Sidney, Ohio.

Union Iron Works, Inc., Bangor, Me.

Owensboro Ditcher & Grader Co., Owensboro, Ky.

SPRAYS, ASPHALT AND TAR

*Kinney Mfg. Co., Boston, Mass.

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Beas Spray Pump Co., Lansing, Mich.

Deming Co., The, Salem, Ohio.

Field Force Pump Co., Elmira, N. Y.

Fitshenry-Gutill Co., East Cambridge, Mass.

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*Austin-Western Road Machy. Co., Chicago, Ill.

*Burch Plow Works Co., Crestline, O.

*Shaw-Eecho Tractor Co., Minneapolis, Minn.

STACKS, STEEL

*Blaw-Knox Co., Pittsburgh, Pa.

*Connery & Co., Inc., Philadelphia, Pa.

*Hell Co., The, Milwaukee, Wis.

*Littleford Bros., Cincinnati, O.

Birmingham Tank Co., Birmingham, Ala.

Chatta. Boiler & Tank Co., Chattanooga, Tenn.

Chicago Bridge & Iron Works, Chicago, Ill.

Honorhor Co., Jos., Cincinnati, O.

Petroleum Iron Works Co., Sharon, Pa.

Pittsburgh-Den Moines Steel Co., Pittsburgh, Pa.

Scaife & Sons Co., Wm. B., Pittsburgh, Pa.

Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STANDPIPES, TANKS AND TOWERS

*Connery & Co., Inc., Philadelphia, Pa.

Caldwell Co., W. E., Louisville, Ky.

Chattanooga Blr. & Tank Co., Chattanooga, Tenn.

Chicago Bridge & Iron Works, Chicago, Ill.

Lancaster Iron Wks., Lancaster, Pa.

Pacific Tank & Pipe Co., San Francisco, Cal.

Petroleum Iron Works Co., Sharon, Pa.

Pittsburgh-Den Moines Steel Co., Pittsburgh, Pa.

United Iron Works, Inc., Kansas City, Mo.

Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STEAM SHOVELS. (See Shovels, Steam)

STEAM TURBINES. (See Turbines)

STEEL PLATE CONSTRUCTION

*Blaw-Knox Co., Pittsburgh, Pa.

*Connery & Co., Philadelphia, Pa.

*Hell Co., The, Milwaukee, Wis.

*Heitzel Steel Form & Iron Co., Warren, O.

*Littleford Bros., Cincinnati, O.

Bethlehem Steel Co., Bethlehem, Pa.

Biggs Boiler Wks., Akron, O.

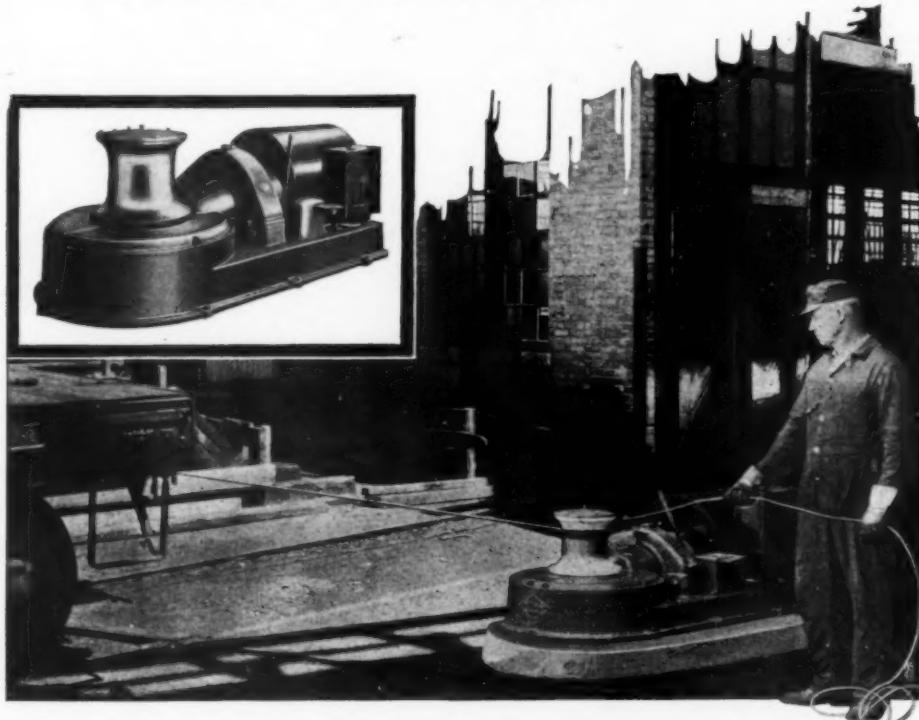
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 Graver Corporation, E. Chicago, Ind.
 Hendrick Mfg. Co., Carbondale, Pa.
 Honhorst Co., Jos., Cincinnati, Ohio.
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 Pennsylvania Bridge Co., Beaver Falls, Pa.
 Petroleum Iron Works Co., Sharon, Pa.
 Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
 Ritter-Conley Co., Pittsburgh, Pa.
 Scaife & Sons, Wm. B., Pittsburgh, Pa.
 Toledo Crane Co., Toledo, O.
 Union Iron Works, Hoboken, N. J.
 Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STOKERS, MECHANICAL

Automatic Furnace Co., Dayton, Ohio.
 Babcock & Wilcox Co., New York.
 Combustion Engine Corp., New York.
 Detroit Stoker Co., Detroit, Mich.
 Sanford Riley Stoker Co., Worcester, Mass.
 Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STREET AND ROAD SIGNS. (See Signs, Street and Road.)

STREET CLEANERS' CARTS

Durlach Can & Iron Works, Brooklyn, N. Y.
 Rochester Can Co., Rochester, N. Y.
 Tarrant Mfg. Co., Saratoga Springs, N. Y.

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 *General Motors Truck Co., Pontiac, Mich.
 *Heil Co., The, Milwaukee, Wis.
 *Kinney Mfg. Co., Boston, Mass.
 Mack Trucks, Inc., New York.
 Autocar Co., Ardmore, Pa.
 Etnyre & Co., E. D., Oregon, Ill.
 Hvass & Co., Chas., New York.
 Federal Motor Truck Co., Detroit, Mich.
 Municipal Supply Co., South Bend, Ind.
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 White Co., Cleveland, O.

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 Chicago Concrete Post Co., Chicago, Ill.
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 Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STREET SIGNS (See Signs, Street)

STREET SWEEPERS

*Austin-Western Road Machy. Co., Chicago, Ill.
 *Good Roads Mach. Co., Kennett Square, Pa.
 *Kinney Mfg. Co., Boston, Mass.
 *Universal Road Machinery Co., Kingston, N. Y.
 Butler Mfg. Co., Cleveland, O.
 Elgin Sales Corp., New York.
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 Kendallville Broom & Brush Co., Kendallville, Ind.
 Lang Broom Co., Pittsburgh, Pa.
 Lay Co., Jos., Ridgewood, Ind.
 Milwaukee Brush Mfg. Co., Milwaukee, Wis.
 Osborn Mfg. Co., Cleveland, Ohio.

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 *Shaw-Enoch Tractor Co., Minneapolis, Minn.

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 Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

TABLES AND BOARDS, DRAWING. (See Drawing Materials.)

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 Birmingham Tank Co., Birmingham, Ala.
 Chicago Bridge & Iron Works, Chicago, Ill.
 Chicago Pneumatic Tool Co., New York.
 Graver Corporation, E. Chicago, Ind.
 Indiana Air Pump Co., Indianapolis, Ind.
 Ingersoll-Rand Co., New York.
 Lancaster Iron Wks., Lancaster, Pa.
 National Tube Co., Pittsburgh, Pa.
 Petroleum Iron Works Co., Sharon, Pa.
 Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
 Scaife & Sons Co., W. B., Pittsburgh, Pa.
 Westinghouse Tract. Brake Co., Wimerding, Pa.
 Worthington Pump & Machy. Corp., New York.

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*Connery & Co., Philadelphia, Pa.
 *Heil Co., Milwaukee, Wis.
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 Biggs Boiler Wks., Akron, O.
 Birmingham Tank Co., Birmingham, Ala.
 Bowser & Co., S. F., Fort Wayne, Ind.
 Case Threshing Mach. Co., J. I., Racine, Wis.
 Caldwell Co., W. E., Louisville, Ky.
 Chatta. Boiler & Tank Co., Chattanooga, Tenn.
 Chicago Bridge & Iron Works, Chicago, Ill.
 Columbian Steel Tank Co., Kansas City, Mo.
 Dover Boiler Wks., New York.
 Farrell Mfg. Co., Joliet, Ill.
 Fouts Co., O. G., Middletown, O.
 Graver Corporation, E. Chicago, Ind.
 Hardisty Mfg. Co., E., Denver, Col.
 Hendrick Mfg. Co., Carbondale, Pa.
 Honhorst Co., Jos., Cincinnati, Ohio.
 Lancaster Iron Works, Lancaster, Pa.
 Pacific Tank & Pipe Co., San Francisco, Cal.
 Petroleum Iron Works Co., Sharon, Pa.
 Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
 Ritter-Conley Co., Pittsburgh, Pa.
 Scaife & Sons, Wm. B., Oakmont, Pa.
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 Walsh & Weidner Boiler Co., Chattanooga, Tenn.
 Wayne Tank & Pump Co., Ft. Wayne, Ind.

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 *Heil Co., Milwaukee, Wis.
 Mack Trucks, Inc., New York.
 Birmingham Tank Co., Birmingham, Ala.
 Butler Mfg. Co., Minneapolis, Minn.
 Case Threshing Mach. Co., J. I., Racine, Wis.

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*Lufkin Rule Co., Saginaw, Mich.
 Dietzgen Co., Eugene, New York.
 Keuffel & Esser Co., Hoboken, N. J.
 Starrett, L. S., Athol, Mass.

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 Mueller Co., Decatur, Ill.
 Smith Mfg. Co., A. P., E. Orange, N. J.

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The World Over

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National Hoisting Engine Co.,
Harrison, N. J.
Northwest Engineering Co.,
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Russell Co., Massillon, Ohio
Vulcan Iron Works,
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Wisconsin Farm Tractor Co.,
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W. T. Young Engine Co.,
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*Barrett Co., New York.
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TAR KETTLES. (See Kettles)

THAWING OUTFITS

*Aeroil Burner Co., Union Hill, N. J.
Hancock Mfg. Co., Brooklyn, N. Y.

TIES, STEEL

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
International Steel Tie Co., Cleveland, O.
Sweet's Steel Co., Williamsport, Pa.

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Pyle-Rogers Corp., New York.

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Fisk Tire Co., Chicopee Falls, Mass.
Goodrich Rubber Co., Akron, O.
Goodyear Tire & Rubber Co., Akron, O.
Kelly Springfield Tire Co., New York.
U. S. Tire Co., New York.

TOOL HOUSES, PORTABLE STEEL

*Blaw-Knox Co., Pittsburgh, Pa.
*Littlefield Bros., Cincinnati, O.

TORCHES, OIL (HEATING)

*Mead-Morrison Mfg. Co., East Boston, Mass.

TOWERS. (See Standpipe, Tanks and Towers)

TRACKS, INDUSTRIAL AND PORTABLE

*Eaton Car & Constr. Co., New York
*Koppel Ind. Car & Equip. Co., Koppel, Pa.
*Lakewood Engineering Co., Cleveland, O.
Atlas Car & Mfg. Co., Cleveland, Ohio.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Fdry. & Mfg. Co., Columbus, O.
Hunt Co., Inc., C. W., West New Brighton, N. Y.
Sweet's Steel Co., Williamsport, Pa.

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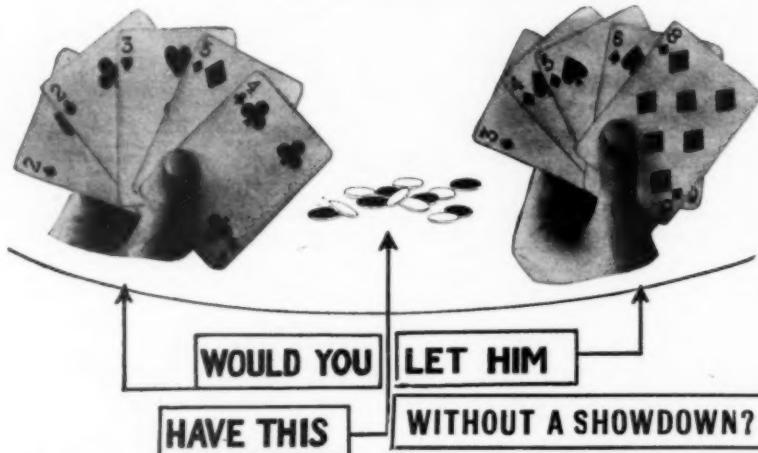
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All Types and Sizes

With or without Scarifier attachment.

Helps you finish the job on time.

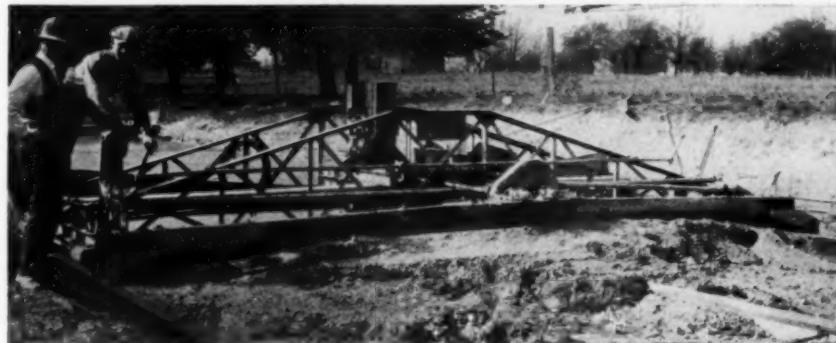
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OSGOOD

It is the stamp of more than 50 years of successful excavating machinery manufacture.

It insures you a time tested product; backed by a concern of long standing.

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Important Features of a \$50,000,000 Construction Job at Kearny, New Jersey

Extensive Dredging, Filling, Pile Driving, Cofferdamming and Concreting Work Involved Some Notable Combinations and Variations of Usual Operations

By A. G. Hillberg

ONE of the most extensive undertakings of recent building construction is the work now in progress on the \$50,000,000 plant for the Western Electric Company, on the bank of the Passaic River near Kearny, N. J., between Newark and New York City. When completed and in full operation, the plant will require about 30,000 employees and will be devoted to the manufacture of telephone cables and other telephone equipment. Its location, adjacent to the site formerly occupied by the Federal Shipbuilding Yard, is on a 60-acre site of low, marshy land, bounded on one side by the river and on the other side by the Central Railroad of New Jersey. It is traversed by a broad, raised highway on a cinder embankment and affords direct automobile communication with New Jersey thoroughfares, while unlimited rail and water transportation are provided by sidings from the railroad and by a river-front bulkhead about one-third of a mile

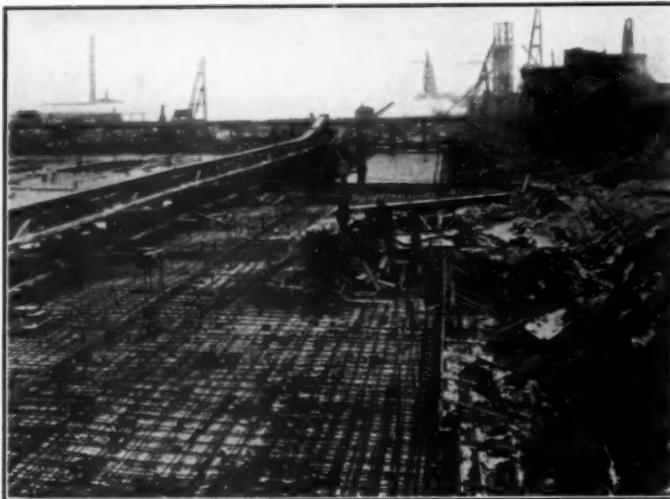
long which affords moorings for vessels drawing 30 feet of water.

Adjacent to the bulkhead there are several acres of mainland, built up above highest tide elevation by about 300,000 yards of sand, dredged from the river-bottom along the bulkhead line, which sufficed for leveling a considerable portion of the area up to the maximum height of the natural surface, about 5 feet above mean high tide. As all of the ground is soft and wet, a uniform system of foundations has been selected, with wooden piles of about 20 tons capacity, driven into a stratum of sand and clay from 15 to 50 feet below the surface and capped at or below low-water level with concrete footings. There will be required in all about 200,000 wooden piles, of which the initial work, here described, comprising about one-fifth of the final installation, has taken about 40,000 piles, generally from 30 to 60 feet long, which were driven by five floating and seven land

FOUNDATION PILES
DRIVEN THIRTY
INCHES CENTER TO
CENTER READY
TO RECEIVE CON-
TINUOUS CONCRETE
FOOTING

In background
locomotive crane with
orange peel bucket
trimming excavation





BELT CONVEYOR
DELIVERING
CONCRETE FOR
REINFORCED FLOOR
SLAB AT KEARNY,
N. J.

machines equipped with five 3,000-pound drop hammers and seven 7-B and 9-B McKiernan-Terry steam hammers driving sometimes more than 100 piles each in a single 7-hour shift.

Land and Floating Pile Drivers

Wherever possible, the piles were driven by the floating machines, which were used even in cases where they could be operated only at high tide. Notable rapidity, accuracy, and economy were effected by driving without cut-off, thus avoiding waste of material and eliminating much labor and expensive appliances, or both, for cutting off the tops on land or under water, and enabling coffer-dam foundations to be completed, ready for concreting, without unwatering the coffer-dam, and in all cases saving a considerable amount of time and labor.

For piles driven by land machines, this was effected by driving a few feet below the surface with ordinary followers, which could be used either with drop hammers or steam hammers. For piles driven by the floating equipment, great success was attained by the use of submerged steam hammers that have recently been perfected and have been used to advantage on important work in Florida, for the Brooklyn Edison Company's power-house in Brooklyn, and for bridge work on the Central Railroad of New Jersey. The standard McKiernan-Terry pile hammers were operated in leads having telescopic extension that enabled them to work as satisfactorily 30 feet below the surface as above it.

Submerged Steam Hammers

Although either steam or compressed air may be used for the operation of the hammer, compressed air is vital for the special provision made to enable the working parts to function perfectly under water. In this case, the hammers were operated as usual by steam up to 100 pounds pressure, and air from three Westinghouse compressors, under pressure equal to the hydrostatic head of submersion, was delivered by a flexible hose with a screw connection to an inlet hole in the bottom cylinder. The standard bottom cylinder is

not air-tight, but the air pressure maintained in it is sufficient to expel the water and insure the operation of all the working parts exactly the same as if above water-level. Another flexible hose carries the steam exhaust above the surface of the water, and the special anvil block, sliding in the leads, is recessed to engage the fitted top of the pile.

Except for these modifications, which can be easily effected on any standard type B steam hammer, the machine is no different from the ordinary McKiernan-Terry hammer and works as easily, as rapidly, and as accurately as if operated wholly above water-level.

The steam hammer is made to engage the telescopic and fixed leads, and, in itself, serves as a holder to maintain the top of the pile exactly in the required position during driving, thus eliminating the necessity of other guides or clamps. The hammer, seated directly on the pile, delivers full efficiency without loss of impact through cushioning, or the interposition of a follower, and can be operated at any depth under water down to the limit of the leads. A guide mark can be placed at any point on a line attached to the hammer, and when pulled tight and compared with a fixed scale, indicates the exact position of the pile top and enables it to be driven to required elevation within a small fraction of an inch. On this work only a small amount of compressed air, at a pressure of less than 16 pounds per square inch, secured highly satisfactory results with all the submerged hammers used, and effected a very large saving of time and cost.

Henry Steers, Inc., was the contractor for the foundations of the 454 x 437-foot cable plant, the 22,000-kw. power-house, the coal- and ash-handling system, a large 6-story building, a condensation water tunnel 250 feet long, and 1,725 feet of a timber bulkhead 40 feet wide carrying a concrete sea-wall that retains a 9-foot fill. This fill, and other top dressing there, required 25,000 yards of cinders and cellar earth, unloaded from 1,000-yard scows by several Hayward clam-shell buckets, operated by floating derricks.

The sea-wall, the 6 x 4-inch intake and dis-

charge tunnel, the footings that topped the foundation piles, and the 6-foot slabs forming the basement floors, required about 35,000 yards of 1:2:4 and 1:3:5 concrete, made with 240,000 bags of Atlas portland cement, about 450 tons of deformed reinforcement bars, and 35,000 yards of graded sand and gravel, dredged, screened and pre-mixed by the contractor.

Foundations on Land and in Water

About 7,000 piles, from 25 to 65 feet long, were driven for the foundations of the 6-story building by the 7 land machines, each operated by a 7-man crew and driving about 40 piles per 8-hour shift. Many of these piles were driven with followers to cut-off elevation about $4\frac{1}{2}$ feet below the original surface of the ground, after which the soil around the pile clusters were excavated to a depth of about 5 feet by $\frac{3}{4}$ -yard Hayward orange-peel buckets, operated by the 45-foot booms of four Browning locomotive cranes, traveling on 5,000 feet of standard-gage track. The 20,000 yards of mud and sand thus excavated was removed by a fleet of twelve 10-yard Koppel and twelve 12-yard Western dump-cars, hauled by steam locomotive and dumped into water 16 feet deep, when it was reclaimed by a dredge with 3-yard dipper that loaded it on 1,000-yard scows, towed to sea and dumped.

About 6,000 of the piles required for the cable plant building foundations were driven to the surface of the ground by land machines, while the remaining 2,500 were driven to water-level by floating machines. Wherever necessary, the earth was excavated to cut-off level. Both land- and water-driven piles were cut to grade by hand and the spaces around their tops were backfilled up to the bottom of the concrete footings. In some places the fill around the pile tops had a strong tendency to slide on the inclined river-bottom and displace the piles so that difficulty was experienced in straightening them. They were pulled as nearly straight as possible, and when this was not sufficient, they were replaced or additional piles were driven alongside.

Enclosed and Cofferdam Foundations

The piles for the power-house foundation were driven to an average elevation of 1 foot above low-water by floating equipment and were afterwards enclosed by an earth dike with a top about 9 feet above mean low water, after which the space around the pile tops was backfilled up to the bottom of the floor slabs, which were concreted directly on the sand. Along the line of the condensation water tunnel the river-bottom was dredged to hard clay stratum about 20 feet below mean low water, and the transverse bents of piles supporting the tunnel were driven by submerged hammers, operated in floating machines.

A timber framework, built on shore, was set in position over the foundation piles by the derrick boats and served as a guide, against which were driven sheet piles, forming a coffer-dam from 20 to 35 feet wide and 250 feet long. At the river end 14-inch arch-web Lackawanna steel sheet piles were driven by steam hammers in floating equipment, but at the other end, where the water was too shallow to operate the floating machines, the wooden sheet piles were driven at the rate of 20 to 30 per high tide by a 4,000-pound drop hammer.

The site of the coal- and ash-handling plant was dredged to hard stratum, the foundation piles driven in it by submerged steam hammers operated from floating equipment, and enclosed by a 64x73-foot coffer-dam of 14-inch Lackawanna steel sheet piles. There were in all nearly 400 tons of sheet piles, all driven by the steam hammers. The coffer-dams were unwatered and the shore-pits were also drained by one 10-inch, two 8-inch, and one 6-inch electrically driven Vortex centrifugal pump, manufactured by the Lawrence Pump & Engine Company, Lawrence, Mass. When the coffer-dams were unwatered, the piles were carefully measured and inspected, and it was found that they were accurately driven to within a small fraction of an inch of required elevations, a minimum of from $8\frac{1}{2}$ to $17\frac{1}{2}$ feet below low water, and within 2 inches of their required locations.

Bulkhead and Sea-Wall

There are in the bulkhead about 4,000 45-foot piles driven to a penetration of about 25 feet and supporting a timber platform 40 feet wide, with its upper surface about half-way between high and low tide. The piles were driven in transverse bents 6 feet apart, each having eleven vertical piles, three batter piles, and one slightly inclined fender pile. The land side of the bulkhead is faced by a continuous line of 8x12-inch wooden sheet piles 30 feet long, which were driven at the rate of 40 piles per 8-hour shift by a land machine moving on top of the bulkhead platform where the water was shallow. Where the water had sufficient depth for the floating machines, they were driven by steam hammers. The bulkhead piles were simultaneously driven in three independent sections with drop hammers and with steam hammers; the latter being submerged and driving to



TIMBER BULKHEAD AND CONCRETE SEA-WALL
Floating pile drivers and concrete plant in background

exact cut-off, while the drop hammer piles were cut off by hand to within $\frac{1}{4}$ -inch of the required elevation. The battered piles were driven chiefly by steam hammers operating in short, suspended leads, guyed to the required angle. Some of them, however, were driven by steam hammers operating in the leads of land machines inclined to the proper position.

Five full-length lines of 12x12-inch longitudinal timbers were bolted to the pile tops to receive the batter piles and to key in position the concrete sea-wall. The tops of the batter piles were also bolted to the transverse pile caps. A large amount of boring for the bolts and spikes was provided for by eight Chicago pneumatic boring tools, the use of which greatly expedited the work and insured stronger and more accurate connections, besides effecting a considerable economy and making the operations more uniform.

Concreting

Part of the concrete was mixed in a stationary land plant, equipped with a 1-yard Ransome mixer that delivered to a bucket in a 160-foot Insley hoist-

ing tower, from the top of which it was sputtered through about 600 feet of Insley steel chutes, supported on two pivoted trusses and suspended from aerial cables. The plant had a maximum record of 400 yards in 8 hours, and was supplied with aggregate from an elevated 10-yard storage bin filled with a Hayward clam-shell bucket operated by a derrick boom and delivering to a Blaw-Knox measuring hopper. The sand and the gravel were unloaded from barges by $\frac{3}{4}$ -yard Hayward clam-shell buckets that deposited them temporarily on the bulkhead and afterwards reclaimed them into a 20-yard elevated loading hopper, which filled two batch dump-cars running about 300 feet over a narrow-gage service track to a 1-yard Ransome mixer.

The concrete for the bulkhead sea-wall, for the power-house, for the condensation water tunnel, and for the foundations of the ash and coal buildings, was chiefly mixed in two floating plants, each equipped with a derrick boom and $\frac{3}{4}$ -yard Hayward clam-shell bucket for filling the mixer bin, a 1-yard Ransome mixer, and a short Insley hoisting tower and revolving truss carrying a chute for sputtering the concrete.

Building the Cheyenne Mountain Road

A 6-Mile Stretch of Road 60 Per Cent Blasted from Solid Rock

THE front cover illustration of this issue of CONTRACTORS' & ENGINEERS' MONTHLY, shows some of the construction work on the Cheyenne Mountain Road built near Colorado Springs. The road makes a brown zigzag scar across the plain face of the mountain. The labor of 120 men for nearly a year and of others for a year and half previous, and the expenditure of \$150,000, are going into this 6-mile stretch of road, 60 per cent of which is being blasted from solid rock. The route to the summit of Cheyenne Mountain follows the old Cripple Creek stage road for a portion of the distance and then up the Cooking Club road, which is being widened from 12 to 26 feet, resurfaced, and supplied with a new drainage system.

The work on the first three miles was the most difficult, the steam shovel having rapidly cleaned up the work on the fifth and sixth miles. Waldron, Benson and Johnson have the contract for 300 feet of roadway on what is known as Switchback 12. The ten men working at that point, 2,200 feet above Broadmoor Lake, packed all their tools and living equipment, plus their groceries, water, and $5\frac{1}{2}$ tons of blasting powder over the stage road to the Sunrise trail, over the Sunrise trail for a considerable distance, and then over a way they sought out themselves to the switchback. When their task was completed, they had shot away the $5\frac{1}{2}$ tons of blasting powder and moved over 14,000 tons of solid granite, building a 300-foot stretch of roadway over which motorists now skim in about 30 seconds.

Six Tunnels

Under another switchback site, six tunnels are driven. In these tunnels 1,750 pounds of dynamite and 2,200 pounds of black powder were cached. The explosion reduced the cliff to rocks which the Osgood steam shovel could either load into the White trucks or nose out of the way. In all, 8,000 tons of solid granite was disposed of. Along

other stretches the steam shovel with the aid of a little blasting plowed its way through fields of boulders, some of them 30 feet high. The explosions on the mountain have been heard many miles away, because of the clarity of the air. When these charges were set off, the stakes disappeared. They were carefully replaced and then usually lost again when the 30-ton tractor and shovel moved over them. Some of the stakes were sunk five to six times in the same place.

In addition to Waldron, Benson and Johnson, the contractors for Switchback 12, Putnam and Webster have handled one of the contracts, and E. Berg & Company handled the contract for another stretch of 200 feet. Their chief work was to lift big pieces of solid rock out of the mountain side. Frequently the men on the higher levels were lost in the clouds, and from the first, occasional snows and unexpected drops in temperatures made the work anything but easy. In making the first survey, C. H. Bryson, the engineer for the work, and his two parties often worked waist-deep in snow.

More than 50 tons of blasting powder and dynamite have been used on this job, moving about 520,000 tons of rock and dirt measuring 200,000 cubic yards. This road is to lead to a restaurant and pavilion at the top which necessitated the expenditure of about \$50,000. The project is nearly as costly, said to be twice as difficult, and yet only one-third as big as the Pike's Peak Auto Highway. There are 22 switchbacks on the entire 8 miles of Cheyenne Mountain highway as compared with 15 on the 18 miles of the Pike's Peak Auto Highway.

The grade at the start of the road is only 2 per cent, while the maximum grade runs up to 10 in a few short stretches, the average being $7\frac{1}{2}$ per cent. The maximum width of the road is 40 feet and the minimum 20 feet. All points which might otherwise be held dangerous are guarded by rail fences, and there are innumerable parking places.

Legal Points for Contractors

These brief abstracts of court decisions in the contracting fields may aid you in avoiding legal difficulties. Local ordinances or state laws may alter the conditions in your community. If in doubt, consult your own lawyer

Edited by A. L. H. Street Attorney-at-Law

Sales of Material by Contractor to Subcontractor

Defendant general contractors for erection of a building sublet the plastering contract to plaintiff under a contract providing that so long as defendants could furnish plaintiff the plaster, etc., needed by him in the work at a cost not exceeding any other price plaintiff could get, he should buy the material through defendants. Interpreting this provision in the case of Van Horn vs. Kemeny, 127 Atlantic Reporter, 233, the Pennsylvania Supreme Court decided that the plaintiff was entitled to materials from defendants at a cost not exceeding the fair market price at the time and place of delivery, if not at best market prices, and that plaintiff was not liable at a higher rate.

Contractor's Responsibility Concerning Foundation Construction

A contract for construction of a building provided:

"In case of soft material under wall at south end, remove and construct wall on 1:3:6 concrete footing." Disposing of a controversy arising under this provision, the Minnesota Supreme Court decided in the case of Carlson vs. City of Thief River Falls, 201 Northwestern Reporter, 942:

"Soft material having been encountered, what was required is plain enough, except that there is no definition of the firm material that would have to be reached for the footing. It would have to be of a degree of solidity sufficient to furnish a proper base for the load it was to carry. The primary responsibility of determining the depth of excavation was on plaintiff [the contractor], and, if he assumed it, he must be held to a strict performance of his contractual duty. . . .

"In such cases as this, contractors cannot complain if they proceed with undetermined matters of consequence without consulting the supervising engineer or architect. The responsibility can and ought to be placed on him by a demand for his professional determination. That is the contractor's privilege under the contract, and if he does not avail himself of it, the whole responsibility is his. But if, with or without a demand therefor, the engineer inspects and approves the work, in the absence of concealment or fraud on the part of the contractor, the responsibility for the result is his, for the contractor is in no wise responsible for resulting defects if he has fulfilled the requirements of the engineer. Approval procured through fraud or collusion or in the face of circumstances showing the impossibility of honest or reasonable approval is of no benefit to the contractor."

Repair Guarantee Contracts Not Valid

Where a statute or charter requires paving repairs to be made at the expense of the city at large, a paving contract binding the contractor to make repairs not due to defective construction, for a certain period, is invalid, holds the New York Municipal Court in the case of Segfried Construction Company, Inc., vs. City of New York, 209 New York Supplement, 429.

The contract involved in the cited case obligated the contractor, not only to construct the pavement, but within a period of five years to "repair and make good . . . all disintegrations, cracks, bunches, defects, open joints . . ." which shall occur at any time in the pavement.

Holding the contract to be void, the Court said:

"Clearly a portion of the contract price represents the value of the undertaking of the contractor to so maintain and keep in repair the pavement during the period of five years after completion. The contract does not, however, indicate what portion of the consideration is attributable to the construction of the pavement, and what portion for the repair during the five-year period of maintenance. It provides that 90 per cent of the contract price shall be paid upon completion of the work, and that the remaining 10 per cent shall be retained and one-fifth thereof paid to the contractor at the end of each year during the period of maintenance. This would seem to indicate that the cost of maintenance was 10 per cent of the contract price, but it is insufficient to predicate such a finding thereon."

It was further noted that under provisions of the Greater New York Charter, "only the cost of the original pavement can be charged to the abutting owners. The city at large must pay the expense of keeping the pavement in repair."

Subcontractor's Foreman Not a Laborer

A statutory bond given by a general contractor to "pay all lawful claims for material furnished or labor performed in the construction of" a highway, did not cover services of a subcontractor's foreman, held the Springfield Court of Appeals in the case of Missouri State Highway Commission vs. Coopers Construction Service Company, 268 Southwestern Reporter, 701. The Court observed that the foreman "was, in effect, the subcontractor's alter ego in so far as concerned the purchasing of material, hiring and discharging laborers, and directing the course of the performance of the contract of the subcontractor." It was also noted that while the foreman at times performed such services as any laborer on the job performed, such occasions were merely incidental, and occurred when help was short.

Basis of Cost Plus Computation

Plaintiff contracted with defendant to erect for defendant two stories to a hotel building at actual cost plus ten per cent. It was agreed that such actual cost should be "the actual cost to the plaintiff of all labor, services and materials used," etc. Overruling plaintiff's claim that the contract entitled him to 10 per cent of the cost of installing elevators, the Iowa Supreme Court decided in the case of George Park & Company vs. Howard Hotel Realty Company, 203 Northwestern Reporter, 247:

"The contract between these parties had reference to the building of the structure. It had no reference in terms to mechanical equipment to be installed therein. The defendant company entered into separate contracts with different persons for the installation of such equipment. The installation of the elevator system was done by the Otis Elevator Company, pursuant to a written contract between it and the defendant at an agreed cost of \$8,000. The plaintiff's employees had no part in such installation."

Lump Sum Bid, Although Irregular, Upheld

Defendant city issued specifications for bids, requiring proposals on each of six minor jobs, as well as the principal work, because it was deemed that all the work could be more economically done in this way. A lump sum bid for all seven jobs was accepted, and plaintiff sued to restrain entry by the city into the contract. Denying the injunction, the New York Supreme Court for Erie County said in the case of Fraser vs. City of Buffalo, 208 New York Supplement, 44:

"The said defendant's bid was admittedly irregular in form, but the harm that usually threatens from such a situation does not threaten here. In most, if not all, the cases cited in plaintiff's brief, the courts restrained acceptance of the irregular bid because of the danger that the bidding contractor would be in a position to gather an advantage from the irregularity of his bid, by claiming that he was required to do less work or furnish less materials than was intended by the specifications.

"In the case at bar no such claim is made. The contract which the city has prepared and the defendant is willing to sign calls for the doing of the main job, and all six of the minor jobs, all with new materials, without using any of the second-hand stuff that is to be torn out. It cannot be disputed that acceptance of the irregular bid of the defendant will result in a saving of the city of \$2,673. Furthermore, no fraud or collusion of any kind is alleged in the complaint or in the moving papers, or suggested in the argument on the motion, and no damage to the city or to the plaintiff as a taxpayer is alleged or suggested, except the damage resulting to his business from the acceptance of a bid considerably lower than his. Under this state of facts, the irregularity hereinbefore described may well be overlooked. The courts themselves frequently overlook irregularities not going to the merits. Why should not other departments of government do the same?"

Contractor's Responsibility for Subcontractor's Fault

A decision handed down by the Alabama Supreme Court draws a distinction between classes of cases where a general contractor must respond to third parties for losses resulting from fault of a subcontractor, and cases where no such responsibility exists. (Thomas vs. Saulsbury & Company, 102 Southern Reporter, 115.) Plaintiff sued on account of injuries sustained in colliding with obstructions placed across a road by a subcontractor in highway construction. Concerning the general contractor's liability, the Supreme Court said:

"One who exercises the privilege of closing a public highway by the erection of barriers thereon owes the duty to the public to so construct same as to be readily seen at a safe distance by ordinary observation. . . .

"The subcontractor, with relation to the work committed to him, was an independent contractor and not an employee. As a general rule, the law of respondeat superior [the legal principle under which an employer is responsible for his employee's wrongs] does not obtain in such case.

"An exception, however, obtains where a duty to the public exists in the manner of executing the work undertaken by the contractor. Such duty exists when the execution of the work tends to create a nuisance; when it is dangerous within itself, as in blasting operations; when the work requires the creation of dangerous conditions, such as ditches and the like in a public highway; or generally when the maintenance of safe conditions in connection with the work is essential to the protection of the public. In such case the chief contractor cannot transfer his public duty to a subcontractor. If the contractor places the performance of such duty in the hands of another, to that extent, that other is in law the mere agent, and the contractor is liable for his negligence."

Right to Avoid Agreement on Ground of Threat

Duress, in law, constitutes involuntary signing of contracts, or other acts induced under compulsion or threats. Defendant unsuccessfully sought to invoke duress as a defense against plaintiffs' suit to recover on a contract to pay \$35,000 as consideration for satisfaction of previous agreements between the parties concerning the proposed construction of a hotel addition. (Irwin vs. Weikel, 127 Atlantic Reporter, 612.) Defendant claimed that he was coerced into signing the agreement sued on by threats of plaintiffs to bring suits for breach of the previous contracts. Overruling this defense, the Pennsylvania Supreme Court said:

"The case presents no features of unusual hardship; defendant seemingly had breached his contract, for which plaintiffs might properly bring suit. . . . There is nothing to take the case out of the general rule that a threat to bring a civil action will not constitute duress. . . . The parties stood on equal terms, and were dealing at arms' length; plaintiffs had no control over defendant or his property, and there is a presumption, not here controverted, that he possessed ordinary firmness."

Notes on the Construction of a Concrete Stadium

By W. K. Hatt

Professor of Civil Engineering, Purdue University

THE Ross-Ade stadium at Purdue University, Lafayette, Ind., is U-shaped, with the half-circle and a portion of the straight sides constructed on an excavated clay bank covered with 6 inches of cinders. The last 100-foot length of the open end of each of the two wings is supported on columns and girders offering space underneath for the dressing-rooms. The stadium fits a natural basin and is so located as to balance the cut and fill. It will eventually seat 23,200 people. At present the straight sides are complete with seats for 13,400 people. The half-circle end is excavated, and terraced with cinders to afford standing room.

The Osborn Engineering Company, of Cleveland, Ohio, designed the stadium and was represented during construction by an inspector. An engineering committee of Purdue University advised the authorities, and the contractor was A. E. Kemmer. Excavation was begun on June 2, 1924. The field was sodded and the concrete complete ready for the most important game of the season on November 22, 1924. The approximate quantities were 50,000 cubic yards of excavation and 3,000 cubic yards of concrete.

There had been an unfortunate failure of a near-by stadium. Two other cases of damaged stadia were in evidence. The situation was such that the university authorities were apprehensive. Those concerned in the construction desired that everyone connected with the job—the contractor, the foreman, the workmen—should realize the necessity for carefully manufacturing the concrete. It appeared useful to exhibit to the foremen photographs of the failed structures just referred to and to make field tests of the concrete from time to time and to communicate the results to the workers. The compressive strengths of the cylinders were exhibited as fast as they became available, contrasting the strength of wetter and dryer mixes, and showing the benefits of proper curing.

The materials used in the concrete were portland cement, washed torpedo sand, and pebbles from $\frac{1}{4}$ -inch to 1-inch proportioned 1:2:3. The standard cement mortar tests (1:3) averaged 229 pounds per square inch at 7 days, and 321 at 28

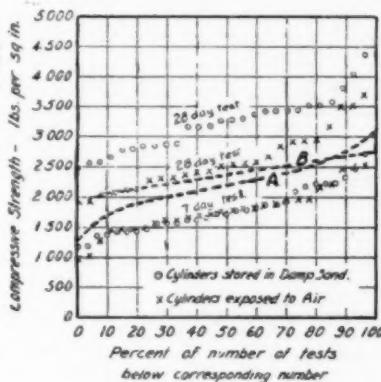


Fig. 2. VARIATION IN STRENGTH OF CONCRETE

Compression test of 6 by 12-in. 1:2:3 concrete cylinders arranged in order of magnitude

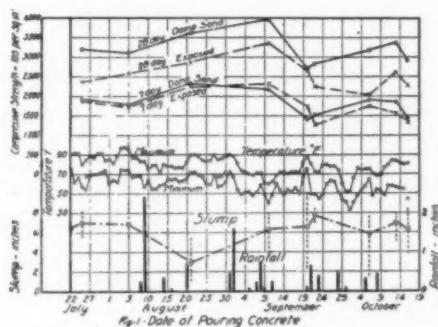
days in tension, and in compression 2 x 4 cylinders, 2,067 pounds per square inch at 7 days, and 3,416 pounds at 28 days.

The moisture in the sand as tested was 4.2 per cent, and in the gravel 2.6 per cent.

The mixer was of $\frac{1}{2}$ -yard capacity without time lock or automatic water control. The operator had had 18 years' experience in mixing concrete. Test cylinders were made at intervals from July 22, 1924, to October 16, 1924, to the number of 114. Some of these cylinders were exposed on the job and some cured in damp sand. The operator of the mixer used his judgment in pouring the water. When the concrete did not work well during placement, word would come back to him to change the amount of water. The samples of concrete taken during any one day were formed into 12 cylinders. For each cylinder a slump record was obtained.

In Figure 1 the slump value represents an average of 12 determinations; the daily range is indicated. The values of strength represents an average of 3 cylinders. It will be noted that as the wetness of the concrete was reduced, the strength values increased, and that the curing in damp sand added very substantially to the strength of the 28-day cylinders. This showing of the benefit of curing brought about a favorable attitude on the part of the foreman, so that the deck was subjected to running water as early as possible. By the careful curing and protection of the surface by canvas, subsequent effects of contraction in the deck are believed to be largely eliminated.

In Table 1 it will be seen that the average slump was reduced from $6\frac{1}{2}$ inches on July 24 to 3 inches on August 20. It is considered that the effects of this dry concrete are shown not only in increased strength but in increased durability and diminished danger of cracking. Of course, such



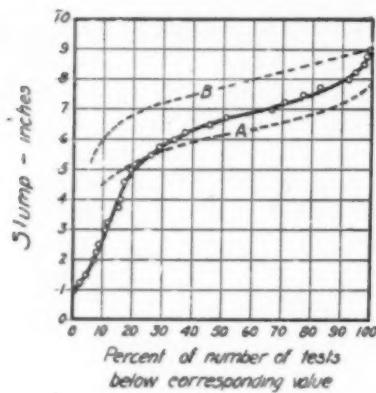


Fig. 3 VARIATION IN SLUMP OF CONCRETE
Slumped 4-8x12 core arranged in order of magnitude

drier concrete needs careful slicing in thin deck risers and treads. Some patching must be expected. My impression is that in portions of the work a slump of 3 inches meant an unreasonable dryness of concrete.

As the work proceeded, the concrete became wetter because of the necessity of rushing the work and possibly the conviction that the exhibited results of strength tests indicated an unnecessarily strong concrete. At any rate, the slump ran up to 8 inches daily average on September 22, with the decreased strength of the concrete shown in the table:

TABLE 1

Dates	Slump, In.	Strength		Damp Sand 28 Days	
		Exposed 7 Days	28 Days		
July 24, 1924..	6½	1,600	2,400	1,650	3,200
Aug. 20, 1924..	3	2,200	2,800	2,250	3,500
Sept. 22, 1924..	8	1,500	2,250	1,550	3,000

Figure 2 shows the customary variability diagram of the strength of the concrete, and a comparison of jobs A and B reported by Messrs. Stanton and Walker in the *Proceedings of the American Concrete Institute* for the year 1924. These jobs, A and B, were 1:2:4 concrete 28-day cylinders. There was much closer supervision

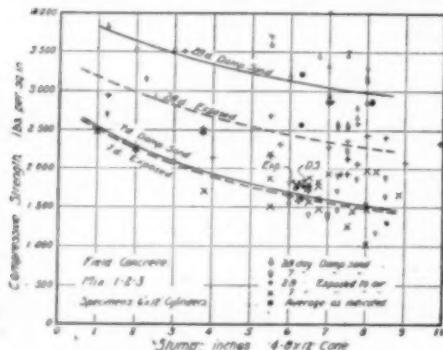


Fig. 4 TEST OF CONCRETE ROSSADE STADIUM PURDUE UNIVERSITY

and better controlled apparatus on these jobs. A comparison of the slump on the Purdue job with jobs A and B is shown in Figure 3.

Figure 4 shows the relation between slump and strength. Each point is the record of one cylinder with its corresponding slump. It will be noted from this figure that 1:2:3 concrete and 6½-inch slump average yielded 3,250 pounds per square inch in damp sand at 28 days. Abrams' tables for 1:1.8:2.9 concrete with from 6- to 7-inch slump, with 0.4 fine aggregate and 4.1 coarse aggregate, indicate a strength of 2,000 pounds per square inch. Possibly the strength of the concrete explains this difference.

Expansion and Contraction

The construction of the Ross-Ade stadium offered an opportunity for measurements of expansion and contraction. One hundred and six gage points were set in the parapet walls and different portions of the decks built on the excavated bank and in the open sections. Thermometer wells were inserted at various depths in the concrete. Observations of change of length and temperature have been made from time to time and will be continued with the hope that representative values of the thermal coefficient of expansion for

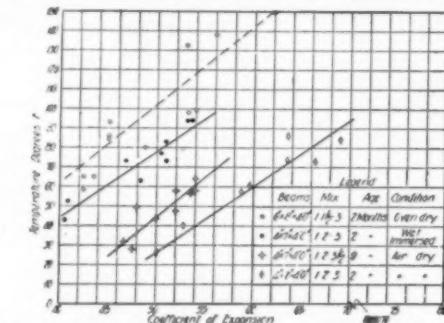


Fig. 5 INTERNAL COEFFICIENT OF EXPANSION OF CONCRETES OF DIFFERENT TEMPERATURES

the several exposures and the amount of contraction due to shrinkage and of expansion due to absorption of moisture will be obtained.

Parallel measurements are made of length changes under laboratory conditions. The complete record of the laboratory investigation is found in a paper by the writer entitled, "The Effect of Moisture on Concrete," presented at the Annual Meeting of the American Society of Civil Engineers, January, 1925.

The complete laboratory investigation just cited indicated that the thermal coefficient of expansion depends on the amount of moisture in the concrete and also on the temperature of the concrete. An average value for 1:2:3 concrete may be taken as 0.000005, see Figure 5. Figure 6 (or E) shows the behavior of beams of the stadium concrete exposed outdoors. Figure 7 shows the contraction of several brands of cement compared to D, the cement used. Figures 8 and 9 show length changes of concrete beams.

The shrinkage of concrete depends among other things upon the richness. A 1:2:3 mix may be expected to shrink eventually to the amount of 0.05 per cent as a result of measurements begun two days subsequent to the pouring of the concrete. During these first two days the greater

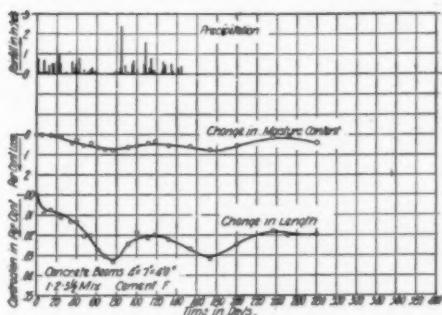


Fig. 6 Showing Contraction of Concrete Exposed to Weather

part of the shrinkage may be expected, unless the concrete is carefully cured. If the concrete is not protected from early drying, this value of 0.05 per cent may be exceeded.

Absorption of water may increase the length of dry concrete in the amount of 0.01 per cent, and under ordinary conditions of exposure this increase in length may be taken as 0.005 per cent. Measurements of the behavior of the stadium to date show that under a drop of air temperature of 38 degrees Fahrenheit the concrete in the open-air deck section of the stadium dropped 37 degrees, the concrete on the bank 24 degrees. The thermal coefficient of the open deck was 0.0000059, and of the revetment 0.0000049. The difference is probably due to the varying dryness or wetness of the concrete. A rainfall and a drop of 10 degrees Fahrenheit balanced each other, and no change of length was recorded in the decks corresponding to a thermal-coefficient of 0.000005 and a swelling of 0.005 per cent.

Interesting observations were made on a parapet wall shown in Figure 10. This parapet wall was 6 inches thick and approximately 3½ feet high and 6 inches thick reinforced at the center of depth with 0.3 per cent of steel each way. This thin wall was integral with a heavy base. Naturally, the thin wall, with its shrinkage and exposure to sudden drops of temperature and being held at the base, was under considerable tensile strength. The steel reinforcement was apparently not enough to prevent a fine crack in the middle of this parapet wall, that is, half-way between the aisles, which were 45 feet on centers. The thermal coefficient of contraction of the top

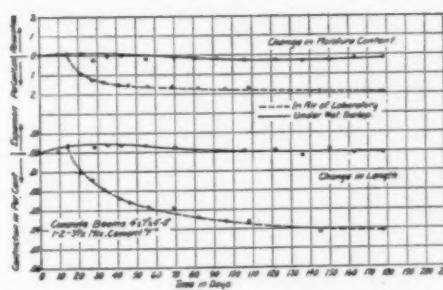


Fig. 8 Showing Change in Length with Change in Moisture Content of Concrete

of this wall was 0.00000725 per degree Fahrenheit, following a drop of air temperature of 38 degrees, which produced a drop of 28 degrees in the temperature of the concrete of the wall. This same coefficient at the junction of the parapet wall with the base was 0.00000305. The parapet wall was poured mostly in hot summer weather, and the crack appeared after the cool nights set in. These cracks, however, closed up entirely during winter weather, and no doubt because of absorption of moisture.

The maximum drop in air temperature from early fall to January was 52 degrees in the concrete. There was a difference of as much as 10 degrees in temperature between the sunny side of the parapet wall and the shady side. The opening of the crack in the middle of the length of the parapet wall was 0.000471 inches per degree drop in temperature.

The expansion joints in this structure were made by placing a ¾-inch expansion joint material against the end of the finished section and pouring the new concrete up against the expansion joint. The latter appears to be too thick and stiff to hold itself in line. These expansion joints are now all open. Where they run parallel with the axis of the seats, water penetrates through the deck to the clay bank and to the team rooms, so that these very narrow openings between the joint material and the face of the concrete will require filling with some undetermined material. It is a question if it would not be better in a job of this kind to form construction joints, permitted to be open slightly and to be afterwards filled with an elastic filler.

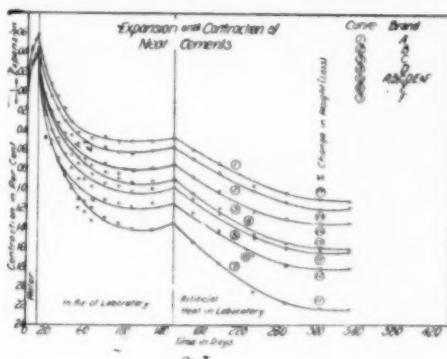


Fig. 7

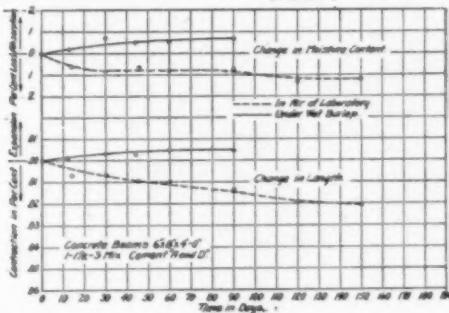


Fig. 9 Showing Change in Length with Change in Moisture Content of Concrete

Conclusion

As a result of experience on an average job of this kind, much can be gained by demonstrating to the foreman the results of tests of the concrete. When foremen come to an actual belief in the effect of variations in the practices, they are much more likely to cooperate with the engineer in securing good concrete.

The variations in quality of concrete on this job are so much greater than variations in the constituent material, that evidently increased uniformity is to be sought in the actual mixing and the placing of the concrete.

On a job of this kind in the vicinity, we have very little doubt about the uniformity and quality of the material. Attention must be paid to the manufacture and the placing of the concrete and subsequent curing. Slump tests made under the eye of the mixer, the results of compression tests communicated as fast as they accumulate to the foreman, and an early protection of the concrete, will certainly largely diminish any hazards there may be under local conditions in pouring a large outdoor structure like a stadium. These structures require more care in selection of material and in manufacture than concrete not exposed to atmospheric influences.

It is gratifying to notice the extension of technical control of materials and manufacture to structures erected by large organizations that include engineering talent. There is, however, a large task to be performed to translate the wealth of scientific information to the average job of concreting. Much of this information must be simplified, freed of forbidding calculations that seem intricate, and attention concentrated on a few simple tests for dangerous aggregates and the

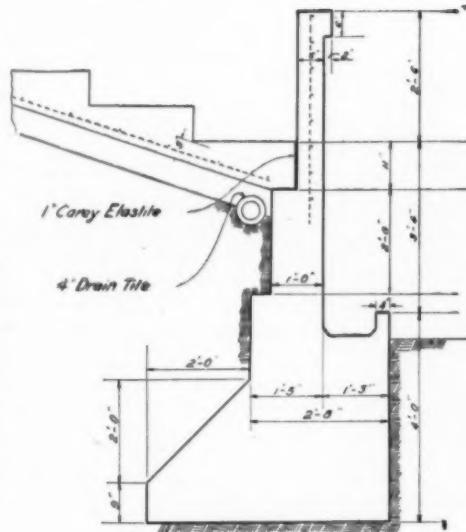


FIG. 10. DETAIL OF PARAPET WALL

essentials of concreting. These should also be performed with the purpose of educating the concreting gang.

ACKNOWLEDGMENT.—Published by permission of the American Concrete Institute from its copyrighted Proceedings, Volume 21, 1925.

Miscellaneous Notes

Monarch Tractor Announces New Appointments

MONARCH Tractors, Inc., Watertown, Wis., has announced the appointment of R. W. Gotshall, as Vice-President and General Manager, and H. B. Baker as Vice-President and Director of Sales. Mr. Gotshall was formerly Assistant Manager of the Holt Mfg. Co., Peoria, Ill., and his experience of seventeen years with that firm included many phases of domestic and foreign sales, designing and engineering, supervision of manufacture, purchasing, and other executive offices. Mr. Baker was Sales Manager of the Holt Mfg. Co. for the last 12 years, and under his direction the sales organization developed in this and foreign countries was the largest and most productive in the industrial tractor industry.

New General Manager for Stockland

THE Stockland Road Machinery Company, Minneapolis, Minn., has announced the appointment of Cal Sivright as General Manager of the company, with headquarters at Minneapolis. For the last eight years Mr. Sivright has been Treasurer of the Minneapolis Steel and Machinery Company and has had wide experience in the manufacturing and selling of general machinery lines. J. D. Frazer, Vice-President,

retires from active management of the Stockland Company to devote more attention to the management of the Lyle Culvert and Road Machinery Company, Minneapolis, of which he is Vice-President and General Manager.

Brooks Now Represents A. W. French & Co.

THE A. W. French & Company, 8440 Lowe Avenue, Chicago, Ill., has announced that the R. E. Brooks Company, 50 Church St., New York, N. Y., distributors, are representing it in the New York territory, superseding the Ginsberg-Penn Company.

Addition to Haiss Plant

THE George Haiss Manufacturing Company, 142nd Street and Park Avenue, New York City, is now completing an addition to its plant, consisting of a 150 x 225-foot one-story building, 28 feet high, equipped with a mezzanine floor of steel, concrete and brick construction. The addition will be used as a machine and assembly-shop and is equipped with one 15-ton 50-foot span electric crane, one 10-ton 50-foot span electric crane, and one 10-ton 25-foot span electric crane. This unit will give the Haiss Company an additional floor space of 40,000 square feet for the assembly of wagon loaders and the crawler attachment for Fordson tractors.

Sewer Construction Progress in St. Louis



CONSTRUCTION VIEW OF WARNE AVENUE PUBLIC RELIEF SEWER, ST. LOUIS

This 13-foot horseshoe type reinforced concrete sewer is being constructed by Blackburn & Crean, contractors, St. Louis, in a very congested residential district at an average depth of 30 feet, 20 of which is through limestone rock. They are using a P & H full-crawler crane with a $\frac{3}{4}$ -yard Owen bucket handling an average of 225 yards of material daily in a tight sheeted trench. Two Fordson A-frame derricks with 22-foot timber booms and a 180-degree swing of the contractor's own design are used to hoist the rock from the trench and load directly into 7-ton Mack trucks. The material above the rock is a heavy clay, which is held by vertical sheeting. This sheeting is operated behind waling pieces and is driven down gradually as the excavation deepens, until the rock is reached, as shown in the lower picture. It is also withdrawn gradually as the backfilling progresses. The backfilling is done by dumping from trucks and is consolidated with air tampers. After a block of sewer has been backfilled, it is thoroughly flooded with water, and considerable settlement follows the flooding.



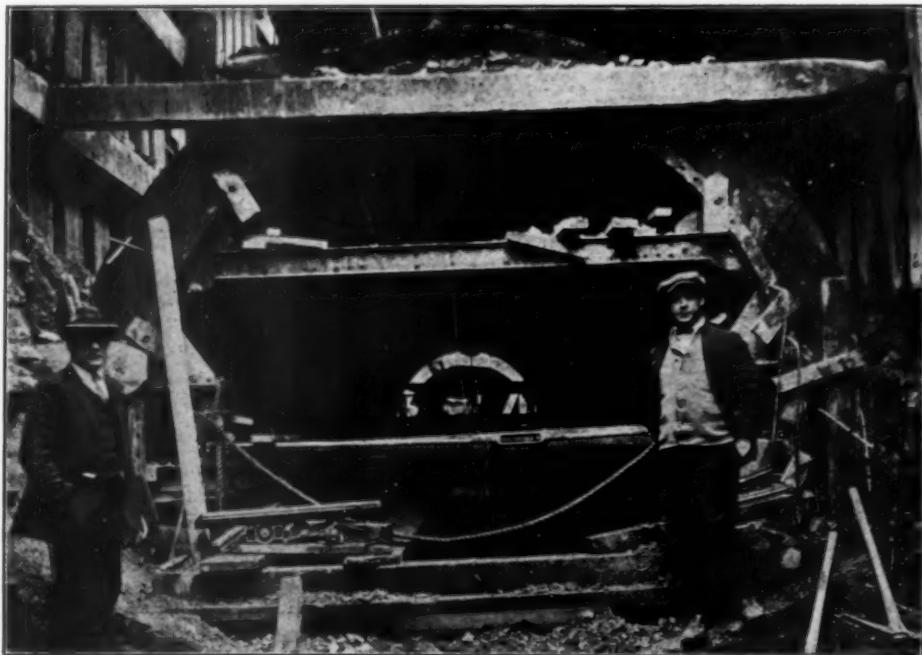
VIEW IN TRENCH OF WARNE AVENUE SEWER

Attention is called to the curtain hanging just above the laborers, which is one of two used in addition to a mat to prevent rock from leaving the trench during the blasting. The curtain is made of 5/16-inch chain and laced with $\frac{3}{4}$ -inch reinforcing bars. This type of mat and curtain has been found very cheap and efficient, as no property damage has resulted from flying stone. The contractors are using one Sullivan portable 220-foot compressor operating at 100 pounds pressure, Ingersoll-Rand Jackhammers and paving breakers. Concrete is being mixed with a Koehring 10-E paver and deposited on Blaw-Knox forms.



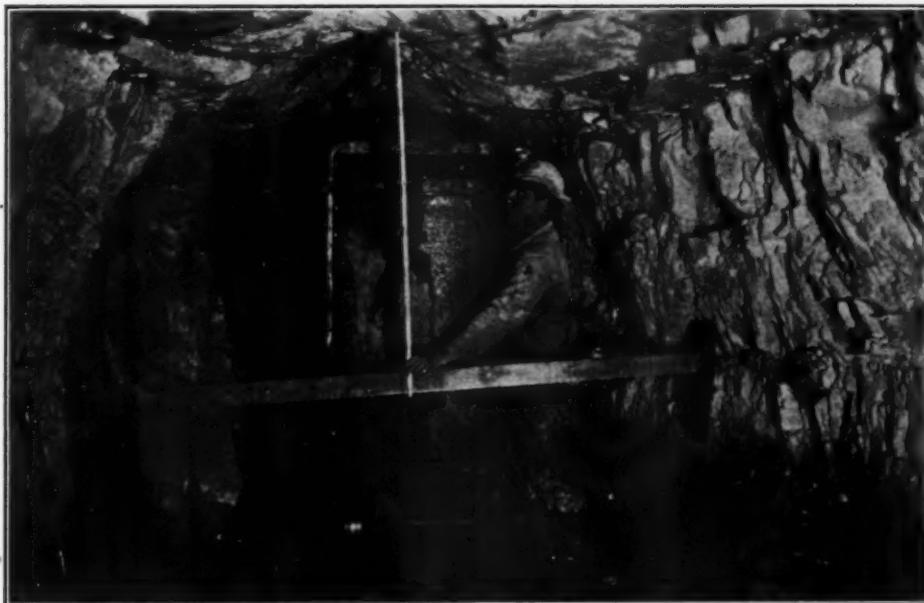
GENERAL VIEW OF SECTION A, RIVER DES PERES DRAINAGE WORKS

The drainage pipe on the left of the trench is a temporary flume, carrying the flow of the River des Peres, while the main sewer is being constructed in the center. This work, after having been delayed badly because of a too low bid by the original contractor, who failed to make proper progress, is now under way, and its completion during the present year is assured. The equipment used on this job consisted of one Monighan walking type dragline excavator with 85-foot boom and 2½-cubic-yard dragline bucket, one Northwest crane with full crawler traction and a 60-foot boom, and a 1-cubic-yard dragline bucket, one Byers crane with 40-foot boom, full crawler traction and a ¾-yard dragline bucket, one 21-E paver with derrick, one Whitcomb and one Burton gas-drive locomotive, and 48 Western 33-cubic-yard batch-boxes. The contractors for this work are J. J. Dunnegan Construction Company, Shenandoah, Iowa.



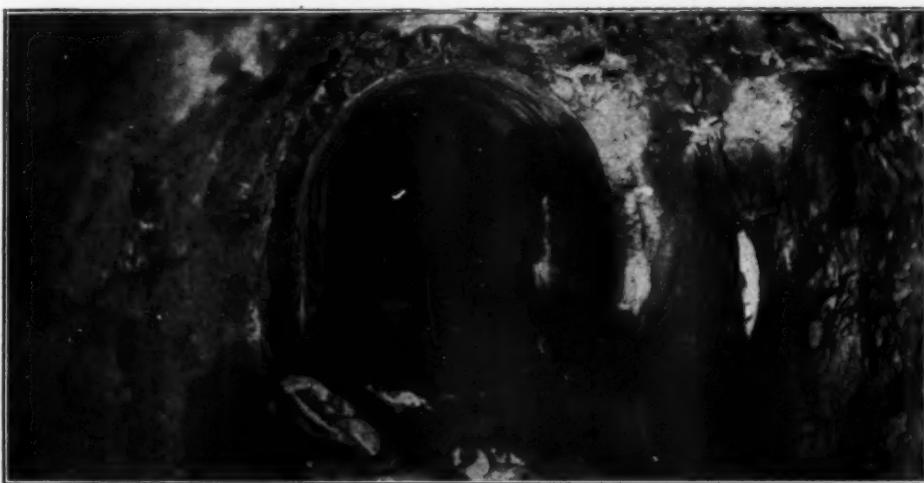
TYPICAL SECTION OF 13- AND 15-FOOT SEWERS BEING BUILT ON SULLIVAN AVENUE, ST. LOUIS

This illustration shows the Blaw-Knox forms in place. The total contract price for this sewer was about \$325,000, construction being carried on well within the estimate and progress being made according to schedule.



CONSTRUCTION SCENE IN THE OHIO-MONTROSE RELIEF TUNNEL, ST. LOUIS

The construction shafts in this tunnel are approximately 1,000 feet apart and 7 x 9 feet in section. The tunnel was driven as a full-size heading, and after hoing through, a separate trimming operation was carried out. A small portion of the work penetrated seamy rock where accurate trimming was impossible and special lining sections were required. In general, the trimming was very close and the concrete lining will probably not average more than 30 per cent in excess of the minimum 6-inch requirement. After the trimming from a particular shaft was finished, the concrete plant was placed at the bottom of the shaft. This plant consists of a small concrete mixer on a platform at the tunnel roof and a pneumatic gun placed immediately under the mixer. The concrete was delivered by compressed air through a 4-inch line to a maximum distance of about 600 feet and placed in the Blaw forms.



VIEW LOOKING TOWARD A COMPLETE SECTION OF THE OHIO-MONTROSE RELIEF TUNNEL

An interesting feature in the construction of this work was the conversion of the shaft above the concrete mixer, as described above, into a material bin. Special bottom gates and partitions were installed and the materials were dumped direct from the trucks at the surface and admitted to the mixer through a measuring hopper. The concrete mixing gang consisted of one cement man at the cement house on the surface, who emptied the cement to the measuring hopper through a pipe at one side of the shaft, one man feeding the mixer and one man operating the compressed-air gun. This contract was carried out by the United Construction Company; L. L. Livingston, as the active officer, and E. J. Burns, Superintendent.



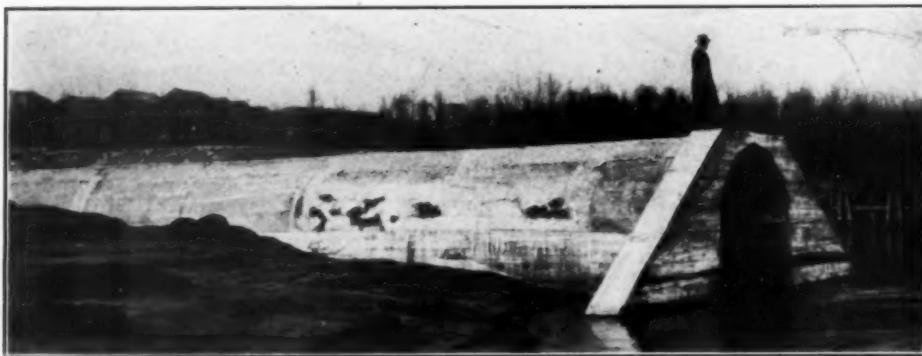
A TYPICAL DISINTEGRATING BRICK SEWER

There is no mortar in the joints of the brick and in many cases the brick has spalled off and fallen out. This sewer is being rehabilitated by filling the joints and plastering the surface of the brick with cement mortar shot in with compressed air, the process commonly called guniting. These old brick sewers are now from fifty to seventy years old. Some were built with lime-mortar and some practically without mortar and are held together largely through the pressure of the earth



COMPLETED GUNITE WORK IN BRICK SEWER

The solid appearance and relatively smooth surface of the finished job is notable. As this work must be done in the old sewers while they are in use, it is of a character which cannot be readily contracted and is being carried out with the direct forces of the Department of Streets and Sewers. About \$200,000 is being expended on work of this character, and it is believed that the life of these sewers will be extended easily for a period of more than 50 years



EXTENDED OUTLET OF THE SOUTHERN SEWER AT THE FOOT OF GASCONADE STREET

Before this work was done, the Southern Sewer ended at the high banks of the river about 500 feet from the water's edge, and the intervening space was occupied by stagnant ponds. The extension of the outlet to the river's edge was carried out during the last year, and the final cost of the contract was considerably less than the original estimate. The ground along this sewer is river mud and sand, and the flow line of the sewer is only slightly above low water in the Mississippi River. Across the ponds the sewer is built on wood bearing piles untreated, and elsewhere on spread footing. It is expected that the ponds will be entirely filled and the sewer almost covered through the sediment laid down by the Mississippi River during the next two or three high-water periods. A great deal of difficulty in the past has developed from the under-cutting of sewer outlets, such as this, both by river currents and by back-eddies of the sewer's own outflow. In this instance a concrete cut-off wall was carried down a considerable distance below low water, and a great amount of heavy riprap stone was deposited in the mud in front of the sewer outlet.



EXCAVATING IN GLASGOW AVENUE FOR THE MAIN SEWER OF THE ROCKY BRANCH DISTRICT NO. 1

This line is an 11-foot reinforced concrete sewer built 25 feet below street level. The work was started last January. The total contract cost was \$670,000, about 30 per cent of which is paid from the sewer bond issue and the remainder in special tax bills. The progress on this work has been the best yet secured in Saint Louis, regardless of working conditions, and has averaged about 30 feet per day, of completed construction. When this progress was made, no rock was encountered and hard clay soil extended to subgrade. Note that the upper portion of the excavation was removed with a Keystone excavator equipped with reverse action shovel dipper; the lower portion by the second machine equipped with clam-shell bucket. All material was loaded direct from the two machines into trucks.



CONSTRUCTION WORK ON THE NORTH BADEN PUBLIC SEWER

This is a 14-foot reinforced concrete sewer extended to drain the unsewered areas in the district near West Florissant and Goodfellow Avenue. Contract for the first section, which amounts to about \$200,000, is about one-half complete.

The Half-Billion-Gallon Reservoir for Tulsa, Oklahoma

Creek-Bed Used as Site by Diverting Flow into Another Stream

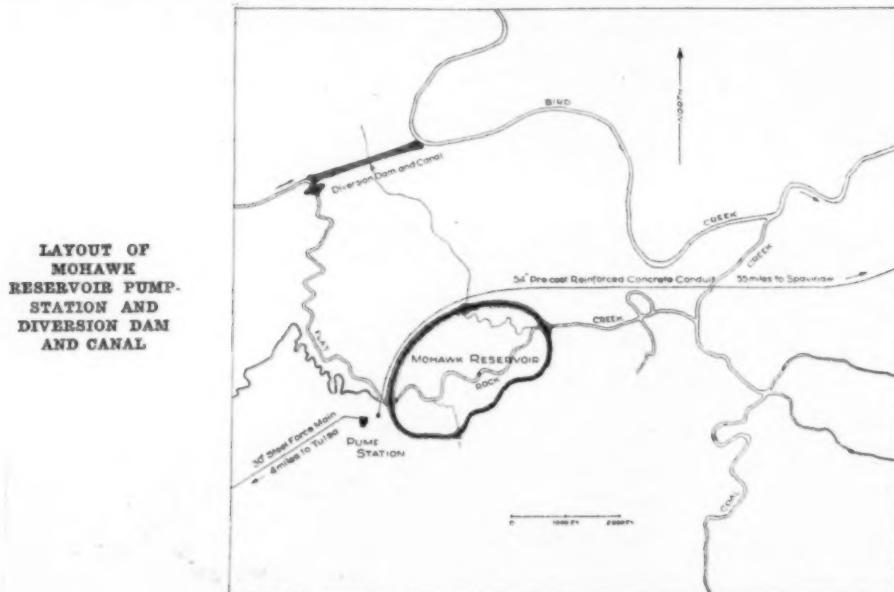
By A. N. Wardle

Designing Engineer, Holway Engineering Company, Tulsa, Okla.

ONE of the interesting features of the Spavinaw Water Project, the new water-supply recently completed for Tulsa, Okla. (and described in earlier issues of this publication*), is the half-billion-gallon emergency storage reservoir at the Tulsa end of the system, known as the Mohawk Reservoir. Briefly, the Spavinaw Project consists in bringing a mountain supply 55 miles by gravity through pre-cast reinforced concrete pipe to the Mohawk Reservoir and pump-station, $4\frac{1}{2}$ miles outside the city, from which point it is

station piping and layout for a filtration plant, should one prove desirable in the future. The storage in Mohawk Reservoir is wholly emergency, to be used only in case it should be necessary for repairs or for other reasons to shut off the flow of water from Spavinaw. Based on present average yearly consumption figures, the reservoir holds sufficient water to supply Tulsa for sixty days.

Advantage was taken of the natural basin furnished by the prairie bottoms and creek channel



pumped to a smaller distributing reservoir and the city mains. Mohawk Reservoir is situated in what are known as the Bird Creek bottoms, a terrain half wooded, half prairie, considerably lower in elevation than the water-level of the Arkansas River a few miles distant, on whose banks Tulsa is built. It was this topographical feature which made practical a gravity supply, for the dam site at Spavinaw is but 10 feet higher than normal low water in the Arkansas, and the crest of the dam is 50 feet lower than the general business district of Tulsa.

The Mohawk end of the project consists of the half-billion-gallon reservoir and the pump-station with aerator. Provision is made in the pump-

for building an earthen reservoir. As will be seen from the accompanying sketch, this was easily accomplished by diverting the flow of Flat Rock Creek to Bird Creek, at a point where these streams most closely approached each other, and using the dry creek basin so obtained as a reservoir site. The diversion canal is 2,248 feet long, with a 20-foot bottom width and side slopes of 1 on 2. The cut varied from 9 to 16 feet and is through a hard clay. A diversion dam through which passes a drain pipe fitted with a flap-gate prevents back water from entering the old creek channel. The diversion canal was completed over two years ago, and since there is a 15-foot difference in level between the two creek bottoms at the ends of the canal, the canal bottom is being gradually cut back. To prevent any possible damage to the diversion

*January, 1924, January, 1925, and February, 1925.



PLACING STEEL
AND POURING SLABS
OF THE CONCRETE
SLOPE LINING UNIT
ON THE MOHAWK
RESERVOIR

Concrete inlet tower
at left center

dam by continued cutting, two timber retards are being placed across the channel, making a series of shallow falls through the canal which will prevent further erosion.

Mohawk Reservoir itself is an earthen embankment 8,360 feet long, averaging 15 feet in height and enclosing slightly over 100 acres of water surface. The entire reservoir area and embankment covers 115 acres. Across the creek channel the embankment is over 40 feet high. About 300,000 cubic yards of material was excavated from within the reservoir to make this fill, incidentally adding 65 million gallons available storage. All borrow-pits were excavated in a manner to make the reservoir bottom fairly uniform, and free from abnormally deep or shallow places, and care was taken that the bottom should drain at all points into the old creek channel. The embankment has a 20-foot top width with side slopes of 1 vertical on $\frac{1}{2}$ horizontal. At a line of contact between fill and natural ground, a false berm of 30 feet minimum width was required before borrow-pit excavation was permitted. In the channel sections, berms of 50-foot width were built at an elevation 20 feet below the top of the embankment, from which point the side slopes continue at 1 on $\frac{1}{2}$.

As additional safeguard against leakage at the deep channel sections, concrete core walls were provided.

The embankment site was first prepared by stripping off the top soil, containing roots and grasses, and furrows parallel to the center line of the embankment were plowed 8 feet on centers and about 14 inches deep. The fill was placed in 18-inch layers rolled with a 10-ton farm tractor. The excavation and placing of the embankment material was largely done by elevating graders, drawn by gasoline tractors, and loading mule-driven, bottom-dump wagons. The remainder was done with plow teams operating with fresno scrapers and wheelers. Two quite different types of soil were encountered. The area north of the creek channel was a black gumbo which compacted well only when deposited in small clods. To accomplish this, it was necessary to set cutting knives on the plowshares of the elevating graders. Two tractors with graders and 20 dump-wagons averaged 1,200 cubic yards of embankment placed per 8-hour day. The soil south of the creek was a sandy clay at times approaching almost a pure sand. This material placed and packed well, but was easily eroded by rains. Fresnos were used to advantage on this part of

AIRPLANE VIEW
OF MOHAWK
RESERVOIR, SHOW-
ING PUMP-STATION
AND RECEIVING
WELL, IN
FOREGROUND, AND
54-INCH CONDUIT
AROUND LEFT SIDE
OF RESERVOIR



the embankment, as the fill was comparatively low. Wheelers were used for topping off and finishing.

Concrete Slope Lining

The embankment, which took ten months to complete, was permitted to stand an additional nine months before placing the concrete slope lining. This is a 4-inch slab extending to elevations 4 feet above and below normal water-level for the purpose of protecting the fill against wave action and erosion. It is reinforced with $\frac{1}{2}$ -inch round bars on 12-inch centers both ways and placed midway of the depth thickness of the slab. There are no expansion joints, the reinforcement being lapped to form a continuous mesh. Normal water-level is 5 feet below the top of the embankment. The 20,000 square yards of paving, including 90 tons of reinforcement, cost \$41,000. The necessary preparatory grading cost about \$9,000, making the total amount of the paving contract slightly under \$50,000.

The paving had been completed two months before the Spavinaw supply reached Mohawk on November 3, 1924, and as the slab had been poured during the hot months of July and August, numerous shrinkage and contraction cracks appeared. All these are very small and are fairly evenly spaced at approximately 8-foot intervals for the entire mile and a half perimeter of the reservoir. As the reservoir filled with water, the embankment settled appreciably, nearly 6 inches, but it was very uniform and had no noticeable effect on the paving.

The reservoir has now been full of water since the latter part of November. Water from the

54-inch Spavinaw conduit first enters a receiving well or control chamber west of the reservoir, where the draft for the city is taken by the pumps and sent to Tulsa. The remainder, which at the winter consumption rate, amounts to 80 per cent of the conduit's flow, or 20,000,000 gallons per day, enters Mohawk Reservoir through a concrete control tower at its west end. Passing through the reservoir, it flows out at the east end over a circular concrete spillway tower into the creek channel, to beautify Tulsa's new park system. Two thousand acres of woods and fields east of the reservoir are being developed into a municipal park and playground, and the overflow from Mohawk Reservoir will provide ample clear and wholesome water for its lagoons and pools. The inlet control tower also serves as an outlet tower whenever emergency may require taking water from Mohawk for Tulsa's use. Sluice-gates permit of drawing off the water for the Tulsa supply at three different levels.

Mohawk Reservoir, including the \$50,000 for slope paving and \$11,000 for the diversion canal and dam, cost \$170,000, which, computed on the basis of 450 million gallons of available water stored, is a cost of less than \$380 per million gallons.

The embankment and canal were built by R. M. Davies & Sons of Tulsa, and the paving was done by the E. G. Fike Company of Tulsa, under the supervision of W. R. Holway, Chief Engineer of the Spavinaw Water Project, and Dabney H. Maury of Chicago, Consulting Engineer. The work was done under the immediate supervision of the writer as Division Engineer.

Miscellaneous Notes

Interesting Building Job in New York

AT 31st Street and Fourth Avenue, New York, an addition is being constructed for the Silk Center Building. Todd, Robertson and Todd are the general contractors, and McKim, Mead and White are the architects. The Thomas Crimmins Contracting Company, 126 East 59th Street, New York City, has the contract for the excavation and foundation. The plot is 100 x 90 feet, the general cellar is 10 feet below the curb and the boiler room is 30 feet below the curb. The total excavation is approximately 6,000 cubic yards. The main part of the excavation was removed by an Erie steam shovel which was afterwards converted into a crane for cleaning up the job and digging pits.

Heil Sales and Service Changes

THE Heil Company, Milwaukee, Wis., has announced the new location for the Heil Northwestern Sales Company offices and warehouse in St. Paul at 2651-3 University Avenue. E. E. Moore and C. R. Sundboom are the distributors in charge of this office, which handles Heil business in Minnesota and North and South Dakota.

The Spinks Supply Company, Inc., Memphis, Tenn., Heil distributors in the Tennessee territory, have announced the change of the firm name to the Universal Equipment Company. They have moved to a new location on Riverside Boulevard.

The Watkins Commercial Body Corporation, Buffalo, N. Y., has been appointed distributor for the Heil Company, in that city.

Staley and Morris Move Offices

STALEY & Morris, Inc., distributors of contractors' equipment in Philadelphia, have announced the removal of their offices to 214-220 North 22nd Street, Philadelphia, where they have 10,000 square feet on the ground floor for their office, display room, warehouse stock, and repair shop.

New Highway Transport Fellowships

MACK TRUCKS, Inc., 25 Broadway, New York City, has recently established a fellowship in highway transport to be devoted to an investigation during 1925-1926, under the direction of the Division of Highway Engineering and Highway Transport of the University of Michigan, covering an approved subject relative to highway transport.

The National Slag Association, Cleveland, Ohio, has also established a fellowship in highway engineering under the Division of Highway Engineering and Highway Transport of the University of Michigan, Ann Arbor, Mich. This fellowship will provide for an investigation under the direction of this division of an approved subject relating to the utilization of blast furnace slag in the construction and maintenance of roads and pavements. The National Slag Association Fellow will make extensive investigations in the laboratory relative to the properties of slag, and in the field pertaining to results secured by the utilization of slag in the construction of different kinds of roads and pavements.

A New Manganese Steel Dipper Front

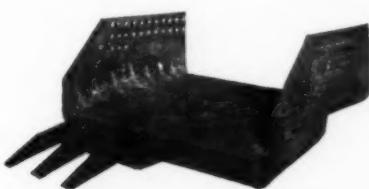
Double Wall Supported by Connecting Rims Forms Socket for Teeth

THE Clark bridge-type dipper front which has been developed by the American Manganese Steel Company, Inc., Chicago Heights, Ill., is a very rugged front with the bottom having a double wall supported by connecting ribs which in turn form sockets for teeth, thus doubling the strength of the dipper lip. The ribs are so arranged that the front may be equipped with the number of teeth that will give the most efficient digging results. For example, a $2\frac{1}{2}$ -yard front has nine sockets and the operator may use three, four, five or nine teeth, depending on the kind of material to be dug and the particular features of the operation. This type of construction results in a cutting edge arranged with a number of square tooth pockets into which are placed alternately digging teeth made of square tool-steel bars and pick-up teeth made of Amsco cast manganese steel. There is also provided under the teeth a small renewable wearing band on the outside of the cutting edge.

The number and length of the tool-steel digging teeth may be readily changed according to conditions, as they are quickly removed and resharpened, since no bolts or other locking devices are necessary. This feature is of particular advantage on digging jobs which require sharp chisel-point teeth to obtain the requisite yardage. After the teeth become worn they may be brought forward by placing small blocks in the bottoms of the pockets



BOTTOM OF BUCKET SHOWING ALTERNATE RIPPING AND LOADING TEETH IN PLACE IN LEFT SECTIONS



ANOTHER VIEW OF DIPPER EDGE

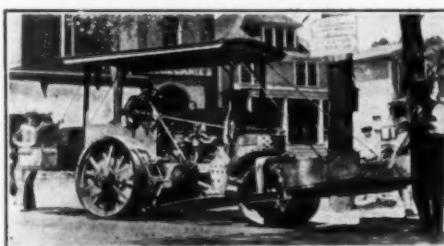
holding the teeth, thus giving them the desired digging length. When the teeth are placed in the sockets they are always in the same plane, thus allowing an even distribution of shock and wear over all the teeth.

The front is made perfectly flat and has the ability to make a smooth, even cut, which is desirable in stripping or digging with power shovels. This flat bottom is so reinforced that buckling is practically impossible, and the digging edge is very strong because of the integral inside and outside walls joined together by numerous braces, forming, as the name implies, the Clark bridge-type front.

Road Roller Carries Repair Materials

Pony Roller at West Pittston, Pa., Has Boxes Added at Front and Back

THE service of a Pony roller made by the Acme Road Machinery Company, Frankfort, N. Y., and owned in West Pittston, Pa., has been materially increased by attaching a box to the front of the roller and one also at the rear. These are very easily carried, being supported by chains and rods from the roof. The boxes are filled with the mixed aggregate used for cold-patch work. The patch is laid and the roller used to compress it as desired. It is reported that this scheme has worked out most economically, as well as being a very speedy way of handling this kind of work. The patches last much longer than if they were just spread in the hole and allowed to be compressed by road traffic.



PONY ROLLER WITH SERVICE BOXES ATTACHED

Ditcher Used for Curb and Gutter Work

Western Contractors Find Ditcher Originally Built for Irrigation Work a Valuable Aid

THE ditcher illustrated below was originally designed for irrigation work, the idea being to make a flat-bottomed ditch which would carry a greater volume of water below the surface. A prominent Denver contractor noted the work done by this machine and tried it out on curb and gutter work, using a medium-size outfit, but the No. 17 ditcher, which has a bottom width of 24 to 32 inches, was found more adaptable. There are a number of these ditchers being used in Denver, Colo., and Cheyenne, Wyo., by contractors who say now that they would not attempt a job on curb and gutter work without a Clinton ditcher made by the Clinton & Held Company, 1501-1511 Wazee Street, Denver, Colo., to open up the space for the forms.

The Clinton flat-bottom ditcher is built all of steel, with no castings nor wood. It is reversible, so that earth can be thrown either way, and the construction of the land side and adjustable shoe on the mold-board prevent it from gouging into the banks where the vertical side of the curb is to be placed. The mold-board is made of high-carbon steel with a machined cutting edge which will scour any soil. The land side is made from plate steel reinforced with angle-iron, and the fin or tail end is beveled so that it will scour. The shoe on the mold-board can be adjusted so that it will either cut $\frac{1}{2}$ or 4 to 5 inches in one operation. A lever is built into the ditcher to operate the adjustable shoe so as to make it possible to



CLINTON DITCHER CLEANING OUT GUTTER BEFORE PLACING OF CONCRETE FORMS

readily clear any obstructions such as immovable boulders.

A Rivet Forge with a One-piece Hearth

New Type of Construction Eliminates Seams Which Rust Out Sooner or Later

ONE of the disadvantages of the sheet-metal rivet forge used extensively by contractors has been that the seams will rust out sooner



A ONE-PIECE RIVET FORGE

or later, making the hearth useless. In addition, while lighter than cast iron, two-piece sheet hearths were quite heavy. To overcome this, the Buffalo Forge Company, 490 Broadway, Buffalo, N. Y., has designed a rivet forge with a hearth made entirely from one piece of heavy steel plate.

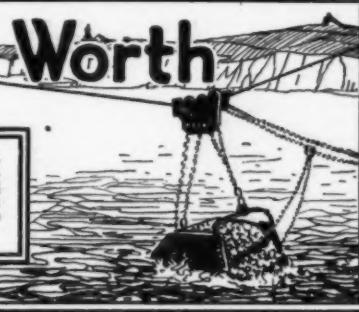
This forge, known as No. 210, is lighter than the old two-piece construction, but is stronger. It has no seams to collect moisture and rust. The features of this forge are its deep drawn 18-inch pressed steel fire-pan with turned-down brim, which serves as a tool rest, and the No. 200 blower with a gear ratio of $47\frac{1}{2}$ to 1.

The equipment of this forge includes a cast iron gear case with inspection cover, an improved blower clamp, a volute type of fan case, four steel pipe legs supported by properly placed leg clamps, a perforated tuyere plate, a steel wind-shield and a fan shaft which runs on New Departure ball bearings. It is easy to knock down and set up this forge because of the way in which it is built. The four legs are held together half-way down and at the top with clamps. The forge weighs 95 pounds, measures 43 inches to the top of the hearth, and its largest leg spread is 35 inches.

Other one-piece steel plate forges are now being placed on the market by the Buffalo Forge Company with hearths 24x24 inches and 24x30 inches, adapted to larger and heavier work.

Catalogs of Worth

The catalogs and pamphlets listed below are available for free distribution. Contractors and Engineers who check over these pages each month and write for such material as interests them, will find this a valuable means of keeping up to date on the subject of machinery and equipment.



MORE JACKING POWER

The catalog of the McKiernan-Terry Drill Co., 19 Park Row, New York City, describes the Doughboy Jack, with which, it is said, one man can do the work of two men with other jacks, because Doughboy Jacks weigh from 50 to 100 pounds less than other jacks of equal power.

ADDED DRAW-BAR PULL FOR FORDSONS

Grid-Iron-Grip wheels which embody the crawler principle in that the shoes come down straight and lie flat, forming a track for the wheel, then lift up and clean themselves, and which add 50 per cent more draw-bar pull to the Fordson tractor, are described in the literature of the Tractor Grip Wheel Co., 2245 Water Works Drive, Toledo, Ohio.

A 3/4-YARD POWER SHOVEL

The Osgood power shovel and its combinations are described in Illustrated Bulletin 256 which may be secured from Carl F. Ebert, The Osgood Co., Marion, Ohio.

AIR-HAMMER DRILLS FOR TRENCH WORK

Bulletin 3981-F issued by the Sullivan Machinery Co., 162 S. Michigan Ave., Chicago, Ill., describes in full Sullivan Rotators, which are powerful 38-pound air-hammer drills that will handle any rock work met in trench work.

ELECTRIC, STEAM, AND GASOLINE HOISTS

Power hoists, operated by electricity, steam or gasoline, as well as cableways and derricks, all of which give a full day's work every day in the week, are described in the literature of the Lidgerwood Mfg. Co., 96 Liberty St., New York City.

A 4-CYLINDER MOTOR ROAD ROLLER

The Huber Mfg. Co., Marion, Ohio, has just issued a new well-illustrated catalog describing its 10- and 12-ton 4-cylinder motor road roller with scarifier attachment.

A SPECIAL CATALOG ON ROAD SCRAPERS

The Baker Mfg. Co., 585 Stamford Ave., Springfield, Ill., has issued a special catalog on Baker-Maney road scrapers, which are capable of handling 500 to 1,000 yards of dirt per day with 2 to 5 men doing all the work.

GASOLINE LOCOMOTIVES THAT STAND THE GAFF

Bulletin 101-IA issued by the Vulcan Iron Works, 1730 Main St., Wilkes-Barre, Pa., tells how 200 to 220 loaded cars were hauled by four 6-ton gasoline locomotives at a repair cost of less than \$30 in one year.

IMPROVED CONCRETE MIXERS

The 1925 catalog of the Construction Machinery Co., Waterloo, Iowa, describes the complete line of Wonder mixers with improved design, increased power-plant, and lower prices.

CAR PULLER SAVES MAN-POWER

Every time you move a car by man-power you are wasting time and labor which could be saved by a Mead-Morrison electric car puller which is illustrated and described in Bulletin 129 issued by the Mead-Morrison Mfg. Co., East Boston, Mass.

A CENTRIFUGAL PUMP FOR CROWDED PLACES

The literature of the Evinrude Motor Co., 276 Florence St., Milwaukee, Wis., tells why the Evinrude centrifugal pump does efficient work at low cost under conditions that foil heavier, bulkier pumps.

NEW ROAD-MAINTENANCE EQUIPMENT

Littleford Bros., 485 E. Pearl St., Cincinnati, Ohio, has recently issued a new 32-page catalog which completely describes the Littleford line of road and street construction and maintenance equipment, including the new improved maintenance heater No. 69 with its eight outstanding and exclusive features, and the regular asphalt heater No. 48, which has been redesigned for additional efficiency.

LEVELS AND TRANSITS FOR BUILDERS

A building contractor does not need a level or transit with a super-sensitive bubble or with a very fine cross-wire. The Warren-Knight Co., 136 N. 12th St., Philadelphia, Pa., will be pleased to send helpful information on this subject as well as its note book Z-A, which contains several pages of cross-section paper useful for recording notes and records, to any contractor interested.

WHAT DOES IT COST TO DIG TRENCHES?

In a circular entitled "Plain Arithmetic," the Harnischfeger Corp., successor to Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis., gives some interesting facts and figures regarding the use of P. & H. ladder-type trenches and wheel-type trenched.

A NEW PLASTER MATERIAL

Walstain, a new interior and exterior wall covering which is said to be water-proof and which will take any finish either on exterior or on interior work, is described in a folder which may be secured from the Louisville Cement Co., Inc., Speed Bldg., Louisville, Ky.

A NEW TRAILER MIXER

The Trail-Bagger, a new portable all-steel constructed mixer made by the American Cement Machine Co., Keokuk, Iowa, which will be of interest to contractors having small jobs in widely separate parts of the community, is described in this company's literature.

A FORDSON SWING-CRANE AND HOIST

The Otis "Labor-Saver" swing-crane and hoist, made by the Otis Engine Corp., 247 Park Ave., New York City, is a valuable piece of equipment for contractors and is described in full in a well-illustrated bulletin which may be secured free on request.

A REPLACEMENT TRANSMISSION FOR FORDS

The Himico replacement transmission, which takes the place of the planetary gear set of the Ford truck and eliminates power losses inside the transmission box, is described in detail in the literature of Hinkley Motors, Inc., Box E-839, Detroit, Mich.

WELL-BUILT MOTORS FOR CONTRACTORS

Motors which are built as a result of experience, with skill and ability, and which have proved their value in the contracting field, are described in literature issued by Power Headquarters, the Continental Motors Corp., Detroit, Mich.

ADJUSTABLE SHORES CUT COSTS

"Cutting Shoring Costs with Symons Adjustable Shores" is the title of a new booklet issued by the Symons Clamp & Mfg. Co., 2449 Sheffield Ave., Chicago, Ill., which describes and illustrates in detail an efficient low-priced shore.

A MIXER THAT STANDS COMPARISONS

The advantages of the Jaeger mixer, including its tilting drum, split paddles, and flat spots inside, as well as the patented tip-over water-tank, power loader, and semi-automatic discharge, make the Jaeger a mixer which stands comparison. The 36 complete mixing outfitts are described in the new complete Jaeger catalog issued by the Jaeger Machine Co., 701 Dublin Ave., Columbus, Ohio.

A WELL-BUILT VELOCITY WATER-METER

The Nilo velocity water-meter, which fits all requirements for measuring large volumes of water, is described in catalog G-54 issued by the Union Water Meter Co., Worcester, Mass.

SMALL EXCAVATOR MOVES BIG VOLUME OF DIRT

Three or four hundred yards of dirt a day is what the Insey excavator has been handling regularly on all kinds of jobs. This outfit, equipped with full-crawler traction, Buda power-plant, cut gears, low center of gravity, and roller bearings, is described in Bulletin No. 47 issued by the Insey Mfg. Co., Indianapolis, Ind.

A NEW MAINTENANCE HEATER

Style A-1 designates a new tar and asphalt heater specially designed for maintenance work and equipped with Connery improved springs, ash-pan and reinforced patented ribs. This is described in full in the Blue Book of Connery & Co., Inc., 4000 N. Second St., Philadelphia, Pa.

PORTABLE LOADERS

Burch portable loaders, which are right o the job, are easily moved, and handle work that you cannot afford to do by hand, doing the work of 17 men at the cost of 3, are described in a booklet giving other contractors' experiences, which may be secured from the Burch Plow Works Co., Dept. MA, Crestline, Ohio.

STEEL TAPES TO REPLACE WOVEN TAPES

Since the only accurate tape is a steel tape, you should replace your woven tapes with Lufkin "Banner," a good steel tape at practically the same price as high-grade woven lines. These are described in the catalog of the Lufkin Rule Co., Saginaw, Mich.

WATERPROOFING AND DAMPPROOFING

The Truscon Laboratories, Detroit, Mich., have just published new revised specifications on waterproofing and dampproofing in the form of a 36-page book which is just the right size for filing in a city official's or contractor's office. It contains complete specifications on waterproofing mass concrete, cement stucco, brick, and masonry, and also on various dampproofing paints, oilproofing, and quick sets for concrete. Ask for Specification Book A.

AN IMPROVED ASPHALT SURFACE HEATER

The improved Lutz surface heater which is operated with a gasoline engine, designed for power and low speed and which can heat without flame from 1,500 to 2,000 square yards of pavement in an 8-hour day, is described completely in the literature of the Equitable Asphalt Maintenance Co., Kansas City, Mo.

A COMPLETE LINE OF CONCRETE MIXERS

The Panama catalog issued by the J. B. Foote Foundry Co., 32 Front St., Fredericktown, Ohio, describes the complete Panama line of concrete mixers from the large batch mixer with side loader or platform down to the small hand-power mixer.

BOTTOMLESS POWER DRAG SCRAPERS

The Green bottomless power drag scraper for excavating, digging and conveying with power has proved an economical unit on many dragline operations. This scraper is described in the literature of L. P. Green, 1234 Monadnock Block, Chicago, Ill.

GASOLINE ENGINES THAT FINISH ON TIME

The literature of the Hercules Corp., Engine Div., Evansville, Ind., describes the sturdy, powerful, single-cylinder Hercules engine, 400,000 of which are now in industrial service equipped with the Wico magneto which provides a red hot spark and an easy, quick start under all weather conditions.

HIGH-GRADE ASPHALT ROADS

It is possible to build high-grade asphalt roads without heating or mixing by the use of Kyrock, which is a natural rock asphalt properly treated for application to the road, forming a smooth, noiseless pavement. Booklet C.E.M. issued by the Kentucky Rock Asphalt Co., Inc., Marion E. Taylor Bldg., Louisville, Ky., describes this product in full.

FORCE-FEED LUBRICATION FOR CONTRACTORS' EQUIPMENT

A well-lubricated steam shovel, drag-line or crane seldom breaks down, as oil at the right time and in the right place furnishes the best possible insurance against breakage. The McCord force-feed lubricator, which supplies dependable lubrication to all parts, is described completely in catalog No. 12 which may be secured from the McCord Radiator and Manufacturing Co., Detroit, Mich.

LONG-LIVED METAL CULVERTS

The installation of long-lived Newport culverts made of genuine open-hearth iron, guaranteed to be 99.875 per cent pure copper alloy, insures your reputation on any road job. Booklets describing these culverts may be secured from the Newport Culvert Co., 542 West Tenth St., Newport, Ky.

HIGH-GRADE PORTLAND CEMENT

Data on the quality and service of Pennsylvania cement for all contracting operations calling for the use of portland cement will be furnished on request by the Pennsylvania Cement Co., 181 East 46th St., New York City.

CONCRETE PRODUCTS MACHINERY

Crescent concrete machinery for making sewer pipe, tile and brick, as well as batch mixers, power block tamper and continuous mixers, is described in the catalog of Raber & Lang Mfg. Co., 831 Mill St., Kendallville, Ind.

GANOLINE HOISTS FROM 5 TO 60 HORSE-POWER

Flory gasoline hoists made in single-drum or three-drum units with or without swinging gears, and from 5 to 60 horse-power, with well-built industrial motors, are described in catalog No. 39 just issued by the S. Flory Mfg. Co., Bangor, Pa.

STANDARD AND STEEL REVERSIBLE ROAD GRADERS

The Good Roads Machinery Co., Inc., Kennett Square, Pa., in its new Bulletin M. T. R. has prepared interesting illustrations and valuable text describing Climax, Standard and Jumbo steel reversible graders.

A FREE BOOKLET ON POWER DRAG SCRAPERS

Sauerman Brothers, 464 South Clinton St., Chicago, Ill., have issued a valuable small-size booklet packed with useful ideas on how to save money in digging and moving earth and other loose materials. It is yours for the asking.

CURING CONCRETE WITH CALCIUM CHLORIDE

How to do away with the old laborious, expensive methods of curing concrete by ponding or by blanketing with dirt and straw and sprinkling with water will be found in Booklet 2053 recently issued by the Solvay Process Co., Wing & Evans, Inc., Sales Dept., 40 Rector St., New York City.

SELF-DUMPING TRUCK BODIES

The Stewart Iron Works Co., Inc., Cincinnati, Ohio, will be pleased to send complete information regarding the new Stewart quick-acting self-dump steel body for Ford trucks.

CHLORINE IN SEWAGE PURIFICATION

This is the title of Technical Publication No. 42 issued by Wallace & Tiernan Co., Inc., Newark, N. J., which that company will be pleased to send to any readers of CONTRACTORS' & ENGINEERS' MONTHLY interested in sewage treatment and disposal.

HYDRAULIC HOISTS FOR DUMP TRUCKS

The service of Wood hydraulic hoists for handling the bodies of contractors' trucks is told in the latest literature of the Wood Hydraulic Hoist & Body Co., 7938 Riopelle St., Detroit, Mich.

A NEW STEEL ROAD-DRAG

The Miskin Scraper Works, Ucon, Idaho, is now manufacturing a new steel zigzag road-drag which has many features of interest and which is able to smooth down "washboardy" highways quickly. This scraper is described fully in its latest circular.

A PORTABLE SCOOV CONVEYOR

The Portable Machinery Co., Passaic, N. J., has recently issued a new folder showing illustrations of the various uses of its portable conveyors and particularly the various types of belts adapted to handling different types of materials.

A SELF-PROPELLED AIR-COMPRESSOR

The Metalweld "Runabout" air-compressor, mounted on a Fordson tractor, which makes it still possible to use the Fordson as a tractor and which provides an efficient, mobile unit, is described fully in the illustrated literature of the Metalweld Service Corp., 26th St. and Hunting Park Ave., Philadelphia, Pa.

PUMPS AND PUMPING MACHINERY

The American Steam Pump Company, Battle Creek, Mich., issues separate bulletins covering the various lines of American-Marsh pumps which it manufactures. Copies of these bulletins will be sent promptly upon receipt of a request relative to the type of pump required.

A ONE-MAN GRADER

The Russell Hi-Way Patrol, a one-man machine with a receding platform allowing the operator full view of the work, a long wheel-base and large wheels with the blade lowered and raised by a worm-gear, is described among other road machinery of interest to the contractor in a complete 72-page catalog issued by the Russell Grader Mfg. Co., Minneapolis, Minn.

TWO-CYLINDER GAS ENGINES

Bulletin AB 500 of the Fuller & Johnson Mfg. Co., Madison, Wis., completely describes its new Model "AB" two-cylinder engines, giving the results of the standard S.A.E. test.

A 1-2-3-DRUM CONVERTIBLE HOIST

Combination O. K. hoist outfits in which the buyer can buy a single-drum hoist and convert it to a double- or three-drum hoist, if desired, without any machine work, are described in literature which may be secured by interested contractors from the O. K. Clutch & Machinery Co., Columbia, Pa.

METAL CONTRACTION STRIPS FOR CONCRETE ROADS

A steel contraction road strip or center joint for concrete highways, designed to meet the requirements of practically every state in which contraction units are specified, is being made by the Milwaukee Corrugating Co., Milwaukee, Wis., and is described in its literature.

A SMALL GAS-DRIVEN CENTRIFUGAL PUMP

Literature describing an efficient small centrifugal pump, direct-connected to a gasoline engine, capable of pumping from 5 to 35 gallons per minute against heads varying from 45 feet down to 10 feet, is described in Bulletin 101-A which may be secured from Crescent Steam Pumps, 1515 Capitol Bldg., Chicago, Ill.

Service on Contractors' Equipment

What Is It?—How Much Can Be Reasonably Expected?—Who Pays?

SERVICE is the misunderstood child in equipment sales. Some disgruntled folks have said it is the nigger in the woodpile, but really it is not as black as painted. Human instinct always craves something for nothing. This something must be paid for by somebody. Free service is a misnomer, because it must be charged off against overhead by the seller or else it becomes a direct charge payable by the purchaser of the equipment on which the service is rendered.

Minor repairs, the furnishing of spare parts, adjustment of the operating mechanism, sound, practical advice on choice of lubricants, and innumerable other items, come under the head of real service. There should be a charge for labor and materials wherever service is rendered by a manufacturer or distributor, unless it is involved in correcting faulty material or workmanship—which will occur even in the best equipment once in a while in spite of the most rigid inspection.

Unreasonable demands for service free or paid are frequently made by owners of construction equipment, either through sheer ignorance, stubbornness, or lack of appreciation of responsibility for their own equipment. Fortunately, this condition is not general and manufacturers and distributors state that in most cases demands are reasonable and payment is promptly made. There are, however, some contractors who still belong to the "something for nothing" class, and it is stories of this type of man that we have collected from various sources, hoping that this mirror will help many readers of **CONTRACTORS' & ENGINEERS' MONTHLY** to understand why a Service Department has its off days and acts peevish. These stories might well belong to the famous cartoon series of "How to start the day wrong." Just put yourself in the place of the Service Department and think how you would feel if one of these kicks reached you the first thing in the morning.

Make a Thorough Examination Before You Ask for a Service Man

All of us are human, and we sometimes become querulous over our troubles before we make a complete examination of the machine to determine the exact location of the difficulty. Only the other night the Editor was unable to get anything on his radio and was ready to pitch it out of the window, when he discovered that his younger daughter had detached the lead-in so that he was trying to operate minus the aerial.

One contractor a hundred miles away from a concrete mixer manufacturer's works called the manufacturer up one day and said that his paver would not work and demanded that a service man be sent immediately. The contractor stated that he had done everything possible to get the machine

back into operation. A service man was rushed to the job. He took out a spark plug, cleaned it, and put it back, and all of the difficulty was solved.

It may be only a spark plug, or it may be that there is a real defect in the machine, but the thing to do is to locate the trouble before a demand is made for service. Practically every manufacturer is more than willing to stand for any expense in the repairing of his equipment if there is the slightest defect in it. The following story is but one of many where a minor defect was quickly remedied:

A large Chicago distributor sold a standard make centrifugal dredge pump to a sand and gravel company operating a dredge plant in Missouri. The pump was to be installed on a barge anchored in the river. Soon after the pump was in place the

superintendent reported trouble, stating that he had tested the suction line as well as the pump shell for leaks and had found none, although he had not used a pressure pump in making his tests. To make sure that there were no leaks in the suction line he had disconnected it and heavily leaded all the threaded joints, but still the pump would not work. The service man went to the plant with the manager of the sand and gravel company, taking a boiler test pump with him. The suction line and the pump shell were filled with water up to the flap-valve, and the boiler test pump was

used to exert the pressure required to determine whether there were leaks in the suction line or the pump shell. The line was tight, but there was a "sand hole" in the shell which made it impossible to maintain a vacuum, and of course the pump would not operate satisfactorily. The hole was plugged and no further difficulty was experienced. The superintendent of the plant should have located the hole, plugged it, and sent the distributor a bill for the material used and the machinist's time, and not insisted on the distributor's sending a man from Chicago to central Missouri to locate a leak the finding of which actually required only 30 minutes' time.

Be Sure to Use the Proper Lubricant

To-day nearly every manufacturer plainly states in his instruction book the kind of lubricant which gives the best results in his machine. Some people try to experiment with other lubricants or perhaps even make a mistake which causes trouble and potential accidents.

A prominent New York up-state distributor reports that he sold a small concrete mixer to a contractor, who soon reported that the machine would not run continuously. Prompt investigation showed that the oil base had been filled with a very low grade of what was apparently some kind of fish oil, which so thoroughly gummed the machine that,

Do You Know What Service Is?

Do you know that service costs money, and must be paid for? Read this collection of selected stories and do your share in cooperating to make better service possible at lower cost by seeking it only when necessary. Read some of the humorous service stories given in this discussion and then watch your step.

while the engine could be started, any load on the drum would stop it. The difficulty was one of lack of supervision, and it was soon straightened out to the satisfaction of the customer, who later purchased three machines of the same make. Had it not been possible to investigate immediately, it is very likely that a prejudice would have been created against this particular make of machine which would have been very difficult to overcome.

Complaints were received by a manufacturer of gasoline hoists that were being used on a big construction job, that the engine bearings were heating so that it was necessary to stop the engine frequently to permit the bearings to cool. A machinist was sent to the job and he found that the crank-case was filled with gasoline instead of the heavy crank-case oil which was specifically recommended by the manufacturer. As soon as the oil was put in the crank-case instead of the gasoline, the engines did not heat. It was particularly fortunate that the operator called the Service Department before the bearings heated to such an extent as to create a spark, or a serious explosion which would have been difficult to explain would have resulted.

The manufacturer of a moderate-priced motor truck received a wire from a contractor in Vermont stating that the motor had set up for some unknown cause, and demanded that a service man be sent immediately. The service man was dispatched at once, and after pulling the motor apart, he found that inadvertently a can of maple syrup had been poured into the crank-case supposedly for oil. This, of course, caused considerable ill feeling, because the truck was new equipment, and the contractor felt rather bad in having the service man show him up.

A road-equipment manufacturer reports that a contractor purchased a crushing plant from him. During the sales talk it was mentioned that the crusher had a water-jacket on it in case it was needed and that few other machines had this feature. Soon after the crusher was delivered, the contractor called for an expert service man, who was immediately sent out to the job. The contractor stated that everything was going well but the crusher leaked water. The expert asked where, and was shown. He promptly stopped the machine, for the reason that the contractor had put the oil in the water-jacket and none was getting to the bearing, while the water had been used to lubricate the main eccentric bearings and naturally leaked out.

Lack of Mechanical Knowledge

Frequently equipment is purchased by a contractor and given to a man who has almost no mechanical knowledge, to operate. This frequently results in unfortunate conditions which are sometimes blamed on the machine and at other times place either the contractor or the manufacturer in a ridiculous position through the demands made for service or through the discoveries made by service men in their travels. Here are a couple of stories which show a lack of appreciation of construction mechanics, another which rivals the safety-valve story in Mark Twain's Mississippi River boat tales, and another in which the operator did not appreciate the safety devices provided for him.

A customer of a reliable southern distributor recently ordered a full set of connecting-rod bearings for a large tractor he had purchased from that company. The connecting-rod bearings were shipped to him at once, as his tractor was tied up and the distributor felt sure that the customer was getting maximum speed in service. A few days

later the same bearings came back, the customer stating that they were too small for his crank-shaft, not realizing that any replacement bearings of this type must be scraped and fitted in place. He then requested that the distributor ship him a full set of connecting rods and bearings complete, thinking probably that these would fit better. In a few days more this full set came back also, with no statement of any kind as to why they were not wanted. The result of all this was an expenditure of several dollars on the part of the distributor, while the customer thought he was getting very poor service, all because he did not know what he was doing.

An operator in West Virginia had two gasoline engines, one of 2 horse-power and the other of 15 horse-power. One day the 15 horse-power engine refused to work, so he telephoned to the factory. After asking the usual questions about compression, adjustment of carburetor, magneto connections, etc., a service man was sent. It took this factory man more than two days to reach the place, traveling by train and horse and buggy. The service man was greeted with the statement that it stood to reason that the size of spark plug used in the 2 horse-power engine would not do for the larger 15 horse-power engine, so that the operator had had the village blacksmith make him a larger one.

One operator of a steam hoist claimed that the safety valve's blowing-off annoyed him, so that he tied it down. Had the manufacturer's service man not happened along and seen this condition, there might have been a serious explosion.

Another operator of an electric hoist complained to the manufacturer's service man that the automatic brake on the hoist jammed and locked when a load reversed, which was exactly what it was designed to do in case anything happened to the electric current. Its function is to hold the load if the current is interrupted, so that it does not drop down and injure workmen below.

One of the bright spots in the life of the service man of a manufacturer of dump-truck hoist equipment is to receive a hurry call from some customer who is quite impatient and cannot give the slightest idea what the trouble is with his hoist. He simply knows that it will not work and further questioning will not reveal any more information. The service man hurries to his assistance and when he gets there he finds that the equipment is not of his company's manufacture, but is that of a competitor. The service man takes care of the customer because he is trained to take care of competitors' equipment as well as his own, thus making a warm friend. This shows that some contractors are absolutely ignorant of the equipment they are using and if they were in possession of enough information they could perhaps take care of the ordinary troubles without summoning a service man.

Sheer Stubbornness

If the manufacturer's service man happens to be in your neighborhood and drops in to see you, it is well to take advantage of his presence and let him look over your equipment, even if it does cost you the price of a 25-cent padlock. It does happen sometimes that a man is not as pleased with a piece of new equipment as he expected he would be, but don't try to pass the buck and place all the blame on somebody else. Take the matter up with the manufacturer, tell him exactly how you feel straight from the shoulder, and nine times out of ten a square deal will be forthcoming that will be satisfactory all around.

A southern distributor tells an interesting story

of the experience of one of his service men who was in a town where he knew there was a small service job waiting and, as he had time to spare, he called on the tractor owner with the intention of cleaning up the job then and there. The owner informed him that the tractor was in a shed with a padlock on the door and the tractor operator was out of town with the key to the door, so that he believed he wouldn't have the work done at that time. A few days later the same tractor owner sent a hurry call for a service man and it so happened that all of the distributor's service men were busy, so that he had to wait two days while his tractor should have been operating, besides having a much larger bill because of the distance the service man had to travel. This man thinks he got very poor service at a very high price—all for the sake of a padlock.

A well-known pump manufacturer placed a new high-grade design of pump on the market to replace a somewhat unsatisfactory obsolete design. A contractor who had previously purchased one of the obsolete design was sold one of the new pumps at a higher price. After he had made the purchase, he thought that he had made an unwise move in paying a higher price. After worrying over this fact for a few days and apparently discussing it with his wife, he decided that the best way out of his imagined predicament was to find some trouble with the new pump, which he knew to be a new design. Accordingly, he reported to the sales office of his district that the pump was very unsatisfactory and would not do the work, giving several more or less intangible objections. The sales office immediately wired the factory, and a service man was sent at once. After the factory representative arrived on the job, the contractor was too busy to even operate the pump, the real reason being that if he had started to operate it, it would have functioned perfectly and his objections would have been killed. The pump was found to be in perfect mechanical condition, and since the contractor refused to place it in operation, nothing could be done. The whole matter was smoothed over by finally selling the contractor one of the obsolete design at the lower price, and everybody was satisfied except the manufacturer, who silently pocketed his loss.

Don't Fail to Read the Instruction Book

Somebody has said that Henry Ford spent a hundred thousand dollars to have a group of master mechanics write up the Ford instruction book so that "any fool could repair a Ford." This may or may not be true, but every manufacturer spends a great deal of time and money in preparing an instruction book on the assembly, operation, and care of his equipment. No manufacturer wants to sell one of his machines and then have it go to pieces, because he loses a satisfied customer and the possibility of a repeat order. Prosperity and good business are founded on mutual satisfaction. Whether you are buying a 50-cent gyroscopic top or a ten-thousand-dollar concrete mixer, it is a good plan to make sure that you or the mechanic who is to operate it reads the instruction book slowly and thoughtfully from cover to cover. The careful reading of the "little red tag" or the complete instruction book in any one of the four following cases would have done away with the necessity for service and would have given the owner the feeling of satisfaction that always comes from conquering one's own problems, be they large or small.

A few days after the sale of a tractor, a southern distributor received a rush call from the purchaser for a service man. On inspecting the tractor, the

service man found that the tractor operator had filled the two steering clutch housings with fluid grease. These clutches being of the multiple-disc dry-plate type, the result was, of course, that the clutches could not hold. In this case the operator had been sufficiently instructed where and how often to grease, but on discovering these two plugs which were really to be used as a drain in case oil should work into the housings, he filled them with grease without consulting his care and operation book, which gave a detailed description of every part and the necessary care of it. The cost of the work necessary to clean these clutches and put the tractor back in running condition was small, but the contractor was delayed for two days in his work, trying to discover where the trouble was located.

A manufacturer of a well-known hitch for scrapers had a long-distance call on the telephone, this time from a dealer, who stated that a demonstration for a contractor was a failure and that he was going to lose the sale of five tractors and five sets of hitches if a man wasn't sent from the factory on the next train to straighten matters out. He was asked if he had read the instructions and used the proper coupling methods, to which he replied that he had tried everything and couldn't get anywhere. The factory man on his arrival found that the dealer had coupled the scrapers in the old horse-drawn way and, although each unit had a large fully-illustrated red instruction tag attached, no one had taken the trouble to read it. It took 30 minutes to change the coupling point to the right location for tractors, but it cost the manufacturer two days' traveling time and the railroad fare because of the neglect of both the dealer and the contractor to read the instructions.

The manufacturer of a gasoline engine which is standard equipment for many pieces of contractors' equipment, issues an instruction book which goes with every engine, and among the list of points to be covered appears the following: "If the engine fails to start, the flow of gasoline to the carburetor should be examined carefully." It is naturally expected that the operator will read the instructions, particularly if he experiences any trouble. This is what happened in one case. A certain contractor in one of the large cities of Wisconsin employing a large number of men in construction work recently experienced considerable difficulty in operating his gasoline engine used in connection with a concrete mixer. Because of the large expense of labor, he immediately took the engine from the mixer, placed it on the running-board of his automobile and drove to the factory, which was more than 125 miles away. On arriving at the factory it was found that a small piece of cork or light wood of some kind had fallen into the gasoline unnoted and, being light, naturally floated into the check valve in the pipe line which carried the fuel to the carburetor. After taking the check valve off, the floating foreign material was instantly found and removed, ending all of the difficulty in the operation of the engine.

A representative of a Chicago firm, handling contractor's equipment, sold a dredge pump to be used in excavating pier foundations for a bridge on a railroad below Baton Rouge, La. The superintendent in charge of the work was an old timer of considerable experience. As soon as the pump was installed, he reported trouble with it and asked that the distributor immediately send an expert to determine the cause. This was not thought to be necessary, because the pump was new and the dis-

tributor was positive that there could not be anything radically wrong with it. Furthermore, it was the busy season and it seemed a shame to send a man from Chicago to Baton Rouge to start an ordinary centrifugal pump, if it was possible to avoid it without undue friction. It was suggested to the engineer that the suction line as well as the pump itself be tested for air leaks and that the line joints be heavily leaded to eliminate any possibility of air leaks. The superintendent reported that he had done all that was suggested and "everything else possible" to make the pump work, but that it simply would not. He demanded the services of an expert or a new pump. The representative went to the job and found that the pump, a belt-driven type, was being run backwards, reversing the proper motion of the impeller or piston. Naturally the pump would not "pump." The representative put a twist in the belt and boarded the next train for Chicago.

A contractor near New York had a bearing "frozen" on the motor. He was working on a penalty clause contract, and the trouble tied him up pretty badly. The service man was sent for and found that the operator had drained the crank-case through a hole about $\frac{1}{2}$ -inch in diameter instead of removing a 6-inch plate as instructed and acknowledged on a signed sheet which this company requires each operator to sign as an indication that each part of the machine has been explained in full. It was found that there was 4 inches of mud in the crank-case, which had plugged the oil line to the bearing, causing it to "freeze."

Carelessness a Breeder of Unreasonable Demands

When a purchaser fails to take reasonable care of his equipment, leaves it out in the rain without proper covering and permits dirt and water to get into the gasoline, nothing but trouble can be expected. Watch your operator and place the blame where it belongs, instead of sending a continuous stream of "kicks" to the distributor. He is in business to make money, just exactly as you are, and his profits are not unreasonably long in any case and are lessened every time service is demanded because of an operator's carelessness. There is another kind of trouble that frequently develops, namely, the alteration of the equipment, not intended by the manufacturer. This frequently throws burdens on shafts and gears that do not belong there, causing breakdowns or unsatisfactory operation. Again, if you need another mechanic on the job, hire a good one, don't expect your distributor to furnish him free of charge.

Three weeks after a well-known New England distributor had sold an expensive portable air-compressor to a contractor, together with two drills which have a reputation for rotating very rapidly and whose speed in drilling is usually much greater than that of the average pneumatic drill, the distributor began to receive complaints, first that the drills were no good, then that the holes would not free themselves from dust. The distributor's service man went to the job with three special drills, and found that the blacksmith did not know how to sharpen the bits and did not even recognize the graduation of the bits in relation to the next succeeding steel. As a consequence, he was binding the drills in the hole. Even after the distributor's service man tried to straighten him out on this point, continual service complaints were received that the steels were breaking. On investigation, it was found that the trouble was that the blacksmith did not know how to temper but plunged the whole

bit in the water at one time, naturally crystallizing the shank. When this was straightened out and the distributor did not feel that he could send a bill for the work, additional complaints were received that the compressor itself would not run. Investigation showed that the gas-tank was filled with dirt. The service man cleaned this out and succeeded in getting the outfit running. About four days later another complaint was received and a factory man went down to the job, finding that the gas line and carburetor were plugged with dirt and water. After cleaning out the entire system, the outfit was started again, when another complaint came in that it was impossible to start the compressor. This time it was found that the cover had been left off the muffler over night during a heavy shower and that water had leaked into the cylinder, making it impossible to fire the gas. All these errors were pointed out to the contractor and in spite of that another complaint which was investigated showed that he had left his gasoline cans exposed without a stopper in them and in pouring them into the tank water and dirt were included. After cleaning out the system again, the contractor was frankly told that any more service would cost him money. This ignorance and carelessness on the part of the contractor cost the distributor more than half of his profits on the original sale. Unfortunately, this is typical of the type of contractor who will do nothing for himself and expects the man who sells the goods on a small margin to stand all the grief. It costs the contractor a great deal of money in the long run, and care in selecting his operator is necessary to overcome such petty and unnecessary troubles as those described above.

A concrete mixer manufacturer reports that a contractor about 50 miles from Philadelphia called up on the telephone stating that the engine on the mixer was laboring very hard while the mixer did not have more than a normal load. The manufacturer advised him in practically every way he knew over the telephone, but to no avail, so a service man was sent to the job. When the service man called, he found that some one had taken off one of the axles which contained two of the drum rollers and the drum was hanging on the back end by the gears, which meshed so hard that the engine jerked. It cost about \$60 for parts and expense to straighten out this job, and the customer expected the manufacturer to pay for it.

A contractor 60 miles away from the manufacturer's headquarters called on the telephone for assistance. When the service man arrived, he asked the contractor what had broken down. The contractor replied that nothing had broken down, but that he wanted two men on the job in case anything did break or get out of adjustment. The contractor stated that he expected this service from the manufacturer without extra cost.

No Gas

The joke of the automobilist who thinks he has a breakdown when he is simply out of gasoline is as old as the first horseless carriage, but the same trouble still bobs up on contracting equipment operated by gasoline engines. Gasoline in a drum five feet away won't operate an engine. Gasoline in the tank won't operate the engine either if there is no connection between the tank and the engine. Some engines are made to operate on either gasoline or kerosene and it is well to make sure just what the proper fuel is for the equipment you buy and then instruct the operator accordingly. It is well

also to see that the wires from the magneto to the spark plug are in place and that the connections are tight.

A sawmill operator in New York State telephoned the manufacturer of a gasoline engine he was using that the engine would not run and was keeping ten men out of work and that if they would not send a service man at once he would ship the engine back. It cost the sawmill owner \$28 to have the service man from the factory put in five gallons of gasoline which was standing within 20 feet of the engine.

A concrete mixer manufacturer had a complaint stating that a service man must be sent at once to start the engine. The contractor had had two garage men go over his engine carefully and they advised that the engine was turned out of the factory in poor condition. When the service department investigated the trouble, it was found that the gasoline line had been taken out of the engine. In spite of this, the customer expected the manufacturer to pay for the cost of sending the service man to straighten out this difficulty.

A contractor 75 miles from the manufacturer complained that his gasoline engine furnished with the concrete mixer would not run. A service man was sent to investigate and after he had worked with it a while he found that the contractor's operator had put kerosene in the tank instead of gasoline.

A certain manufacturer sold one of his machines to a contractor in Maine. The contractor telephoned to the district office that he could not start the engine on the machine. The service department tried to go over the matter with him by telephone, but the contractor was not satisfied and requested that a service man be sent at once. It cost the company \$85 to send the service man out. He found that the wires from the magneto to the spark plug had been stolen while the machine was in transit.

Too Much Expected of the Machine

An unusual situation has arisen in the case of concrete finishing machines, as reported by one prominent distributor. This brings up the question as to whether the salesman is overselling the idea of a perfect job by the machine or whether because the machine is advertised as being able to put a perfect finish on the road the contractor naturally expects that it will surmount any difficulties. This equipment is new and naturally the user does not know as much about its history as he does with a fresno. He doesn't expect a fresno to go through tough clay and clean up on the first trip; instead he sends a rooter plow through to loosen up the material. It is all a question of adjusting the various units that are working together to produce the final result. Most contractors have found the concrete surfacing machine a most helpful piece of equipment.

One prominent mid-states distributor has found that contractors expect a road-finishing machine to produce a perfect surface on the road, no matter what the condition of the subgrade or the concrete mixture and how it is deposited on the road or how it is "puddled" ahead of the finishing machine, the amount of water used and a dozen other conditions, all of which enter into the condition of the surface aside from the actual operation of the road-finishing machine itself. It seems rather unreasonable that a contractor should expect the finishing

machine to leave a perfect road under any and all conditions, but this seems to be what is expected. This distributor has found that in starting up and demonstrating machines of this type his troubles begin after the machine has been all set up and put in perfect operating condition.

Be Explicit When Ordering Parts—It Means Better Service

The following story has appeared in the technical press and has been passed around from mouth to mouth as a running mate to the story about the foreigner who couldn't find the crank to start his gasoline engine and wrote a most profane letter to the manufacturer about it, ending with the postscript, "Never mind I found the dang thing."

A manufacturer of dirt-moving equipment received a telegram from a customer asking that he be sent a pair of wheels for his Blank grader. As he had originally bought the machine without front wheels for use with a tractor, it was concluded that he now desired to equip it with front wheels for team operation. Accordingly, two front wheels were sent to him. As soon as they arrived, he fired back the following telegram, "Rear wheels, back wheels, hind wheels, dammit." Had he used any of these terms except the last in his original telegram as he should have done, his order would have been filled correctly.

Complete Cooperation Makes Service Cheaper and Better

These tales of trials and tribulations are going to have a happy ending, first, because no one can possibly read them without wondering if he has ever been in a somewhat similar position, and, secondly, because in closing we present an incident where the contractor and manufacturer got together to their mutual benefit.

One Saturday at 10 o'clock in the morning a manufacturer received a request from a customer 100 miles away asking to have a certain casting weighing 200 pounds delivered on the job that afternoon. By arrangement, a man started out from the factory in an automobile carrying the casting and the contractor started out from his camp toward the factory at the same time, meeting the factory man approximately half-way between the points. The casting was transferred to the contractor's car and delivered on the job as he had requested. This illustrates what can be accomplished when a contractor is reasonable and willing to meet the manufacturer half-way, both figuratively and actually.

The Manufacturer's Responsibility

No manufacturer can afford to permit any salesman to oversell the idea of service to the point where he makes the purchaser think that service is like the manna of old and comes direct from the skies without cost to anyone. Most of the stories produced in this discussion have come from manufacturers. There may be many others from contractors which might show that the instruction book was written by a mechanic that was too much of a master and not practical enough to produce a text readily understood by the every-day operator. We have held the service mirror up to the contractor, the manufacturer, and his representative, and to ourselves. Let us all work for better, more reasonable service—that great creator of goodwill.

Standard Questionnaires and Financial Statements for Bidders

Joint Conference on Construction Practices Complete Valuable Aid to Determine Responsibility of Bidders

FOR some years public officials have been faced with growing conditions in the construction industry which have not only been annoying but have frequently resulted in detriment to communities. A study of the problem has shown a tremendous increase in irresponsibility and inexperience in the construction industry, due in large measure to the rapid increase in construction since the war and the large number of new organizations in the field.

Public officials are realizing that defaults add to construction costs and that delays in the completion of contracts due to such defaults deprive communities of the economic use of the improvement and frequently result in heavy losses.

The annual expenditure in general construction throughout the United States is approximately six billion dollars, of which approximately two billion dollars is for highway construction and maintenance. The interest of the public demands in that expenditure the greatest economy consistent with efficiency.

The Committee on Uniform Questionnaires to be used in determining the responsibility and experience of contractors in the construction industry, does not criticize anyone because there may be a disagreement as to the causes which are contributory to the present conditions in the construction industry, but they do believe there are some fundamentals that are worthy of serious consideration. The construction industry, along with all other industries, is important to the welfare of the entire country and, if it is to be useful, it must be successful. It must be encouraged by recognizing responsibility and experience, which should insure efficiency and therefore economy.

Two Important Points Brought Out in Investigation

Investigation as to some of the causes for the present economic conditions in construction has developed:

First, a custom more or less common throughout the country due to the interpretation of a somewhat general law governing the award of contracts for public works which provides that the contract be awarded to the lowest responsible bidder. This determination of responsibility in many communities is limited to the ability of the contractor to purchase a bond, with little, if any, consideration as to his ability to perform the contract.

Second, competition between surety companies has been very keen, with the result that many bonds have been written which did not insure responsibility or experience.

The result of thorough investigation and careful study of the problems facing public officials and all interests allied with construction has developed a recognition of a definite obligation of cooperation between all elements if the public is to receive the benefit that will result from responsibility and experience. If the interest of the public is to be safeguarded in the expenditure of such large sums of money as are involved in construction, there must be a thorough and intelligent investigation and

consideration of the bidder's qualification to perform the work. In some of the states the public officials are recognizing their obligation of definitely determining the responsibility and experience of the bidder.

Increasing Use of Questionnaires

The Board of Public Works, Division of Highways, of Illinois on March 20, 1924, announced a new policy involving the filing of questionnaires on finance, experience, and equipment by contractors bidding upon their work. About one year later Frank T. Sheets, Chief Highway Engineer of Illinois, stated that the adoption of a questionnaire had been of great benefit in carrying out state highway construction.

In response to an appeal from L. A. Boulay, Director of Public Works and Highways, the Attorney General of Ohio ruled early last year that it was the duty of public officials to award their contracts to the lowest and best bidders and that the word "best" must take into consideration all the qualifications of the bidder. After consideration of the most effective procedure, Mr. Boulay on behalf of his department adopted a policy similar to that of Illinois, involving the use of questionnaires.

Georgia and Virginia report the adoption of policies for determining responsibility and experience similar to those used by Illinois and Ohio. Wisconsin reports a policy of classifying contractors according to responsibility and experience and holding the award of contracts within these classifications. Similar steps have been taken by the Tennessee Department of Highways and Public Works.

Forms Prepared

The accompanying forms are unqualifiedly recommended by the Joint Conference for use in connection with the award of either public or private contracts, and it urges that they be given a thorough test. Any modifications shown by experience to be advisable can then be made. The Joint Conference is composed of participating committees from the American Association of State Highway Officials, American Institute of Architects, American Institute of Consulting Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, American Society for Municipal Improvements, Associated General Contractors of America, Highway Industries Exhibitors Association, National Association of Casualty and Surety Agents, and the Surety Association of America (Committee on Better Underwriting).

Forms Reproduced

On the following pages are reproduced the approved forms for the experience questionnaire and the plant and equipment questionnaire. The forms for the contractor's financial statement, which are in considerable detail, will appear in the October issue.

EXPERIENCE QUESTIONNAIRE

Submitted to.....
By.....
Principal Office.....

{ A Corporation
 A Co-partnership
 An Individual

The signatory of this Questionnaire guarantees the truth and accuracy of all statements and of all answers to interrogatories hereinafter made.

1. How many years has your organization been in business as a general contractor under your present business name?.....
2. How many years experience in.....construction work has your organization had: (a) As a general Contractor.....(b) as a Sub-Contractor.....
3. What projects has your organization completed?

Contract Amt.	Class of work	When Completed	Name and address of Owner
.....
.....
.....
.....
.....
.....
.....

4. Have you ever failed to complete any work awarded to you?..... If so, where and why?
.....
.....
5. Has any officer or partner of your organization ever been an officer or partner of some other organization that failed to complete a construction contract?..... If so, state name of individual, other organization and reason therefor.
.....
6. Has any officer or partner of your organization ever failed to complete a construction contract handled in his own name?..... If so, state name of individual, name of Owner and reason therefor.
.....
7. In what other lines of business are you financially interested?

8. For what corporations or individuals have you performed work, and to whom do you refer? _____

.....
.....
.....

9. For what cities have you performed work and to whom do you refer?.....

.....

- 10. For what counties have you performed work and to whom do you refer?**.....

.....

11. For what State Bureaus or Departments have you performed work and to whom do you refer?.....

.....

12. Have you ever performed any work for the U. S. Government? _____
If so, when and to whom do you refer? _____

.....

13. What is the construction experience of the principal individuals of your organization?

CONTRACTORS' & ENGINEERS' MONTHLY

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PLAN AND EQUIPMENT QUESTIONNAIRE

Submitted to: _____

By _____

Principal Office

- { Corporation
 Co-partnership
 An individual

The signatory of this questionnaire guarantees the truth and accuracy of all statements and of all answers to interrogatories hereinafter made.

1. In what manner have you inspected this proposed work? Explain in detail.

.....
.....
.....

- 2 Explain your plan or lay out for performing the proposed work.**

3. The work, if awarded to you, will have the personal supervision of whom?

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4. Do you intend to do the hauling on the proposed work with your own forces?

If so, give amount and type of equipment to be used. _____

5. If you intend to sublet the hauling or perform it through an agent, state amount of sub-contract or agent's contract, and, if known, the name and address of sub-contractor or agent, amount and type of his equipment and his financial responsibility.....

.....
.....
.....
.....

6. Do you intend to do the grading on the proposed work with your own forces?.....
If so, give type of equipment to be used.....

7. If you intend to sublet the grading or perform it through an agent, state amount of sub-contract or agent's contract, and, if known, the name and address of sub-contractor or agent, amount and type of his equipment and his financial responsibility. _____

8. Do you intend to sublet any other portions of the work?..... If so, state amount of sub-contract, and, if known, the name and address of the sub-contractor, amount and type of his equipment and his financial responsibility.

- 10. What equipment do you own that is available for the proposed work?**

11. What equipment do you intend to purchase for use on the proposed work, should the contract be awarded to you?

- 12. How and when will you pay for the equipment to be purchased?**

.....

13. Do you propose to rent any equipment for this work?..... If so, state type, quantity and reasons for renting.

14. Have you made contracts or received firm offers for all materials within prices used in preparing your proposal? Do not give name of dealers or manufacturers.

Dated at _____ this _____ day of _____

-19-

Name of Organization

R_M

.....

STATE OF _____ } **ss.**
COUNTY OF _____ }

and that the answers to the foregoing questions and all statements therein contained are true and correct.

and that the answers to the foregoing questions and all statements therein contained are true and correct.

Sworn to before me this

...day of..... 19..

Notary Public

My Commission expires.....

A New Trailer Type Mixer

Two-Wheel Truck-mounted Mixer Adaptable for Wide Variety of Small Jobs

CONTRACTORS active in doing work for telephone companies, street railway companies, and gas companies, as well as those having numerous small jobs such as pouring short flights of concrete steps and similar work, will be interested in the Boss Trail-Bagger mixer, which has been developed by the American Cement Machine Company, Keokuk, Iowa. This unit has been devised with the primary object of making it possible to handle two concrete jobs twenty or so miles apart on the same day and every day.

The steel trucks as well as the compact construction of this unit make the mixer readily portable. The two-wheel truck has solid rubber tires and roller-bearing wheels, which, with the wishbone lift hitch giving a 10-inch road clearance, makes it possible to attach the Trail-Bagger to any truck and to tow it at any speed without whipping.

All-steel construction for this unit has reduced the weight over 1,000 pounds, while it still maintains ample capacity and durability. It is equipped with either power loader or low charger.



A TRAILER TYPE MIXER WITH HARDENED STEEL ROLLER BEARINGS

High-Capacity Portable Air-Compressors

New Units Are Both Gasoline- and Electric-driven

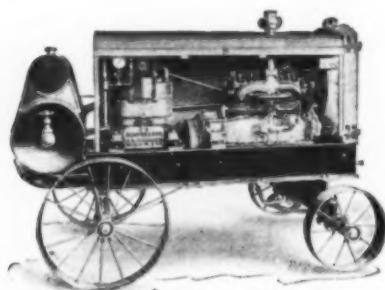
THREE sizes of portable gas-engine-driven compressors are now being produced by the O. K. Clutch & Machinery Company, Columbia, Pa., to meet the demand for a reasonably priced high-capacity compressor. The frames of these units are standard structural members, electrically welded. The radiator is of a special design with cast iron head, tank, and side members, and a special type of high-efficiency core which cannot be broken by freezing. The units are mounted on standard 4-wheel trucks of sturdy construction with steel-tired wheels as standard; rubber-tired wheels or spring mounting can be secured.

All units use a compressor of the same type, the only difference being in size. All parts that require adjustment are accessible. The valves are

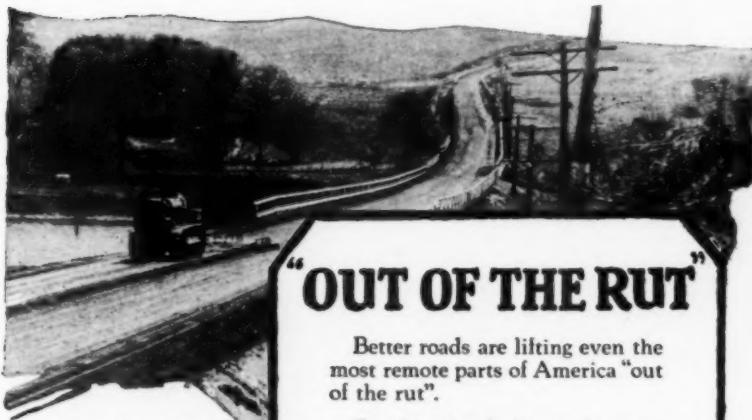
removed by taking off bolted caps without removing the head, a feature much appreciated by mechanics on the job. Large hand-hole plates are provided on each side of the crank-case, and all bearings are die-cast and can be easily replaced if necessary without disturbing the piping or tearing down the whole machine. The cylinders are of close-grained gray iron, accurately machined. The cooling system is claimed to be particularly efficient. The cylinders are cast en bloc and completely surrounded by the water-jacket, and the suction and discharge valves which are located in the cylinder head are also surrounded by water. Cold water from the radiator is fed to the compressor and from the compressor to the engine.

Air valves are of the Duo Plate type, made of special hardened steel with a separate plate over each port. Light weight and small lift give them long life and noiseless operation. Valve-closing is accelerated by springs, and the ports are machined all around to provide uniform lap around the circumference.

The gasoline engine for driving this unit is a standard 4-cylinder, 4-cycle, heavy tractor type direct-connected to the compressor by a special O. K. clutch and coupling, giving full flexibility and easy dismounting, and insuring ease of starting the engine in cold weather. The engine is of the L-head type with 4-point suspension and is rigidly attached to the main frame. A standard throttling governor is furnished, and in addition a special suction valve unloader is provided in connection with the O. K. carburetor control, which speeds up the engine before the load is thrown on the compressor.



NEW PORTABLE COMPRESSOR



A beautiful stretch of road
—well maintained with a
"Caterpillar" Tractor

"Caterpillar" Tractors
pioneer for industry generally
and for agriculture. Their
usefulness extends to the out-
skirts of civilization, breaking
virgin sod, hauling logs, or
minerals or supplies, or creat-
ing roadways.

"OUT OF THE RUT"

Better roads are lifting even the
most remote parts of America "out
of the rut".

For this, thank those who have
wisely invested road-building
money in sturdy and efficient
road-machinery, and thank "Cater-
pillar" Tractors.

A mighty task has been done!
There is a big task still to do!
Wherever there are roads to build,
there is work for "Caterpillar"
Tractors.

Let us send a catalog.

CATERPILLAR TRACTOR CO.

Executive Offices
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A "Caterpillar" 10-Ton grad-
ing a well crowned dirt road.



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sizes of "Cat-
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tors.
**10-TON
SIXTY
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THIRTY
2-TON**

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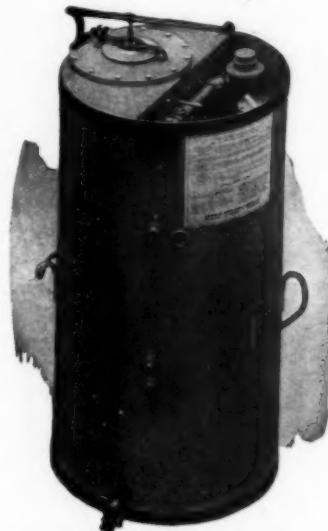
A New Portable Low-Pressure Acetylene Generator

Outfit Has New Principle of Feed Control

A SMALL generator for producing acetylene at low pressure for welding and cutting has recently been developed by the Oxfeld Acetylene Company, 30 East 42nd Street, New York City. This unit, which takes 35 pounds of carbide at one charge, can be transported readily from place to place, thus providing a portable supply of generated acetylene gas. Empty, the generator weighs only 210 pounds.

An entirely new principle of feed control is used which might be called a "heavier-than-water" float. A vertical partition, extending nearly to the bottom into a water-seal, divides the generator shell. One side is gas-tight and contains the carbide hopper at the top. The upper part of the other side contains gas-regulating and protective devices and an automatic carbide feed control. Generation of the first acetylene causes water to rise on this side of the partition high enough to all but submerge a pan full of water hung to a control lever. This pan normally acts as a weight acting counter to a spring, but as the water rises above it, its apparent weight is diminished and the carbide hopper valve is closed by the action of the spring. As the acetylene is drawn off, water rises in the gas department and correspondingly lowers under the float, relieving some of the buoyancy of the water pan, which, gathering weight with the receding water, depresses the spring and allows a small amount of carbide to drop into the generator, thus restoring equilibrium.

Because of its low center of gravity, the generator rights itself when tilted at an angle of 30 degrees. It works satisfactorily at an inclination of upwards of 10 degrees. No adverse effects result if the generator is knocked over while in operation. Nearly all the fittings are enclosed in



THE NEW OXFELD LOW-PRESSURE ACETYLENE GENERATOR

the cylindrical shell and there is little, if anything, projecting which may be injured by a fall even on a concrete pavement. The generator has been submitted to the Underwriters' Laboratories, Inc., and has been listed by them as an acceptable device for installation on premises carrying fire insurance.

Comparative Dirt-Moving Costs

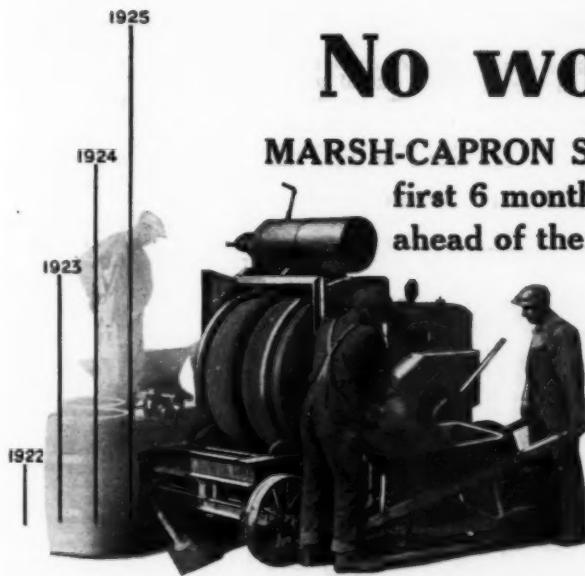
One-Man Power Scrapers versus Team-Wheeler Equipment

A VERY interesting comparison of dirt-moving costs between a Miami one-man power scraper with a Fordson tractor and team-wheeler equipment has been prepared by the Miami Trail-r-Scraper Company, Troy, Ohio. The following figures for the cost of operation of a Fordson tractor and one-man power scraper are abstracted from these data:

Original investment in tractor and Miami one-man power scraper f.o.b. factory.....	\$969.00
Depreciation per day (based on 50 per cent per year, 200 working days to year).....	2.48
Tractor driver (50 cents per hour for 10 hours).	5.00
15 gallons of kerosene (including cost of gas for starting)17
Lubricating oil, $\frac{1}{2}$ gallon.....	.40
Allowance for repairs in addition to above depreciation, \$150 per year of 200 days.....	.75
Interest on investment (\$962), 200 days.....	.30

Cost per day of 10 hours each for tractor and scraper operation	11.10
Cost grade man per day.....	1.00
	\$12.10

Allowing 15 per cent wasted time per 10-hour day leaves $8\frac{1}{2}$ hours' actual work. Figuring 2 hours per day for plowing with the tractor leaves $6\frac{1}{2}$ hours per day for actual scraper work. On a haul of 200 feet or 400 feet round-trip, the Miami scraper unit will load, transport and dump 18 cubic feet of dirt every $2\frac{1}{2}$ minutes. This results in 24 trips per hour multiplied by $6\frac{1}{2}$ hours, the actual scraper hours worked per day giving 2,808 cubic feet or 104 cubic yards per day. Dividing 104 cubic yards into \$16, which is the actual cost of the scraper, tractor, and grade man per day, gives $1\frac{1}{2}$ cents per yard for moving dirt with this outfit.



No wonder

**MARSH-CAPRON Sales for the
first 6 months of 1925 ran 759%
ahead of the same period in 1922!**

Your MARSH-CAPRON distributor is able to give bigger mixer values—that's why we are now doing a far larger business than ever before in the past fifteen years.

Contractors who have "tried them all," who know mixer values—the big general contractors who put a lot of material through a mixer

and want nothing but the best—are buying MARSH-CAPRONS in fleets.

Concerns like Owen, Ames, Kimball, Mid Continent Const. Co., Spencer, White & Prentis, Inc., Burrell Engineering & Contracting Company, and others in the same class are buying one big MARSH-CAPRON mixer after another. And a lot more concrete contractors are doing exactly the same thing in placing their orders for mixers of smaller sizes.

Here are the reasons why MARSH-CAPRON distributors are breaking all their past records for mixer sales:



M-C Universal Tilting Mixer. Capacity 3½ cu. ft. mixed concrete. Trailer or Steel Truck Mounting.



M-C Universal Drum-type Mixer. Size 3½-S. Trailer or Steel Truck Mounting.



M-C Universal Mixer. Sizes 5-S and 7-S. Trailer or Steel Truck Mounting.



M-C "Rail-Track" Building Mixers, sizes 14-S, 21-S, and 28-S.

(1) Contractors have spread the news that the MARSH-CAPRON is a much better value—*better built, regardless of price paid.*

(2) These mixers actually give what the contractor has so often been promised—*lower-cost concrete.* They save time at every step in the mixing cycle—each detail that governs the charging, mixing, discharging is worked out right on a MARSH-CAPRON.

(3) They're extra sturdy machines built stronger all the way through—your best assurance that the work is going to move right ahead. Bigger channels make a stiffer main frame; rail tracks protect the drum from outside wear. The drum turns on deep-chilled mine-car-wheel rollers, with over-sized bearings. Drum gear is bolted on in segments. And

you'll see other points like these all over the machine.

(4) The only mixers ever built to carry a definite guarantee covering the trade-in value—also a guarantee protecting the user on rebuild cost.

(5) Prompt and efficient service on repair parts—with low prices for parts.

(6) A complete line—with a mixer of the right size and type for every contractor doing any kind of concrete construction. The M-C line includes 3½-T and 6-T tilting mixers, and "rail-track" mixers in sizes 3½-S, 5-S, 7-S, 14-S, 21-S and 28-S. Also the Marsh-Capron "Universal" Mortar and Plaster batch mixer.

The quickest way to check up the bigger values in Marsh-Capron Mixers is to *make comparisons for yourself.*

MARSH-CAPRON CO., 11 South LaSalle St., Chicago

When writing to advertisers, please mention the Contractors' & Engineers' Monthly—Thank you.

Cost of Operation of Teams and Wheelers

Allowing what may seem a generous allotment of labor, the table below gives the cost of operation per day of teams and wheelers on an average dirt-moving project:

3 teams and drivers and 3-wheeled scraper at \$7 per day.....	\$21.00
1 snatch team and driver at \$7 per day.....	7.00
1 plow team and driver at \$7 per day.....	7.00
2 men to load wheelers at 40 cents per hour..	8.00
1 man to dump wheelers at 40 cents per hour..	4.00
1 man to plow at 40 cents per hour.....	4.00
1 grade man $\frac{1}{2}$ of total time.....	2.50
	\$53.50

Allowing 15 per cent wasted time per 10-hour day gives $8\frac{1}{2}$ working hours. A number 2½ wheeler holds 16 cubic feet of material; allowing a haul of 400 feet round-trip the same as for the power scraper requires 5 minutes for each team per load, resulting in 12 loads per hour or 36 loads per hour for three wheelers, or 18½ cubic yards per day. This yardage, costing \$53.50 per day as noted in the table above, gives 29½ cents per yard.

These figures, if correct, show an actual saving of 18 cents per yard of dirt moved. In moving 2,600 yards this would mean a saving of \$468.



PUMP SUCTION
SERVED BY 1 1/2-YARD
DRAG BUCKET

River Bottom Used for Fill

Large Tract of Low Land on South Bend River Front Filled in by Dragline and Suction Dredge
By C. N. Pollock

A REAL estate organization in South Bend, Ind., is taking the bottom out of the St. Joseph River and making dry land out of it by filling a large low-lying tract near-by. For years this tract was idle and too low to build on.

About a year ago the idea of dredging the river was conceived, with a view to filling in this low tract with the sand and gravel. During the fall and winter operations went forward with a Green dragline bucket, operated by a 50-horse-power Novo gasoline hoist. The bucket was dragged across the river bottom, bringing with it $1\frac{1}{4}$ yards of gravel at each trip. This was dumped on the low land. This spring operations were changed, the gravel and sand being brought to the river's edge and then pumped by a Hetherington-Berner pump, operated by a 150-horse-power General Electric motor. This 8-inch centrifugal pump handles about 1,900 gallons of water a minute with the sand and gravel. The material is carried through 165 feet of pipe to the top of a 45-foot tower, where the gravel is screened from the sand. The gravel is to be used to build the foundation for asphalt pavement in this district. The water flows back into the river. M. G. Calef is the engineer for this work.

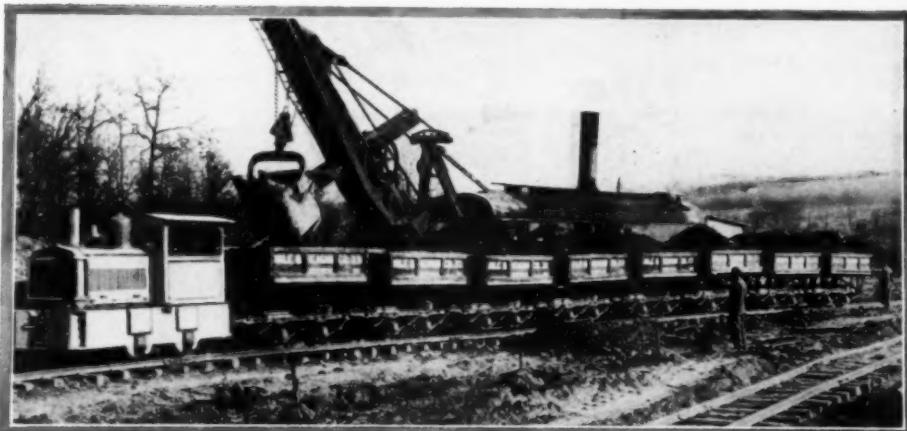
AMERICA'S GREATEST DAM—MUSCLE SHOALS, ALABAMA

By Wm. Benjamin West, Assoc. A.I.E.E.; Associate Editor, Commercial News Record, Second edition, revised. Frank E. Cooper, New York. 1925. 61 pp. \$1.00.

A descriptive book replete with large-size illustrations of the various parts of the Muscle Shoals Project. To those wishing a permanent record of this gigantic government undertaking this book will be of interest.



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Horses with Steel Heads Take Practically No Space When Not in Use

A COLLAPSIBLE horse for contractors, carpenters, painters, masons, and other construction workers has been developed by the Taylor Collapsible Horse Company, 730 West Harrison Street, Chicago, Ill. This horse is made up with steel heads and side pieces of timber. It requires only a moment to take it apart and put it together. No nailing or bracing is required, and the horse can be easily handled and moved from one job to another. There is little storage expense, as these Taylor collapsible horses take up practically no space when stowed away.

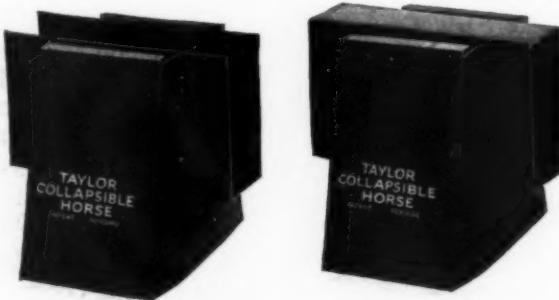
The manufacturers claim that the cost is actually lower than that for an ordinary horse, taking material, storage space, and ease of moving into consideration. A horse can be made any size desired, using head No. 500 at each end and as many heads Nos. 600 as may be necessary for center supports. The Taylor collapsible horse has passed very rigid laboratory tests at the Armour Institute of Technology, Chicago, Ill.



COLLAPSIBLE HORSE SET UP READY FOR USE

TYPES OF HEADS USED ON TAYLOR COLLAPSIBLE HORSE

At left.—Head used at ends.
At right.—Head used in center for supporting long horses



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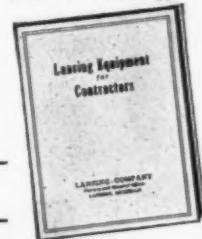
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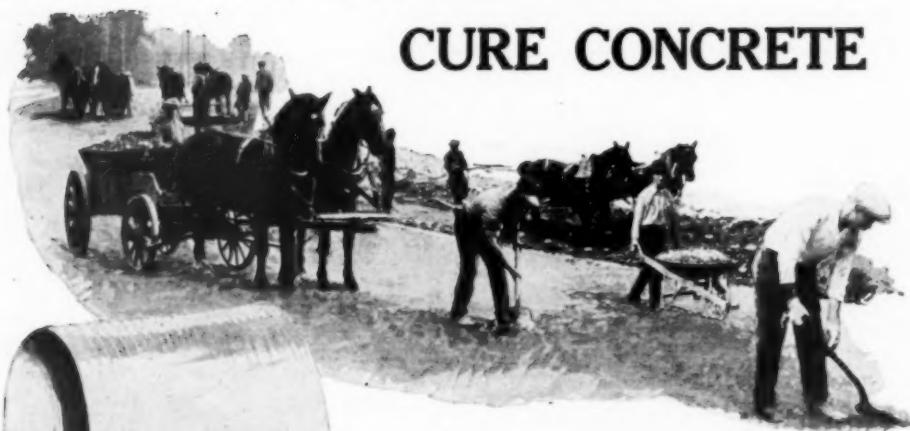
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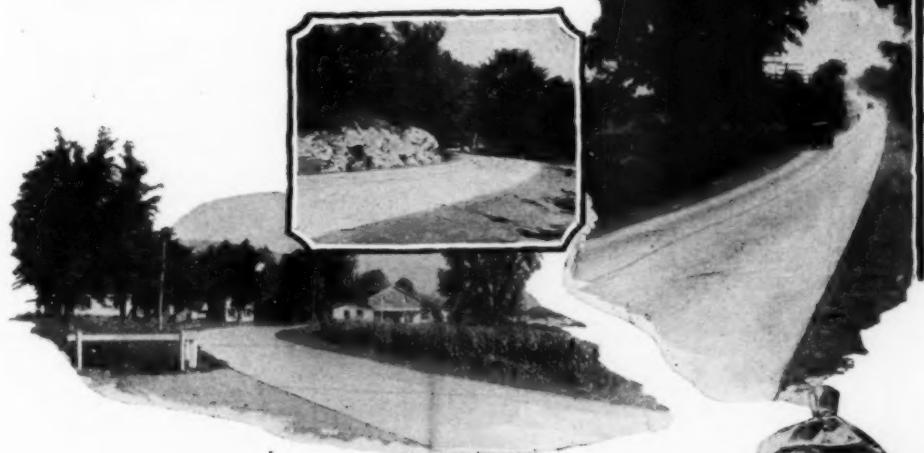
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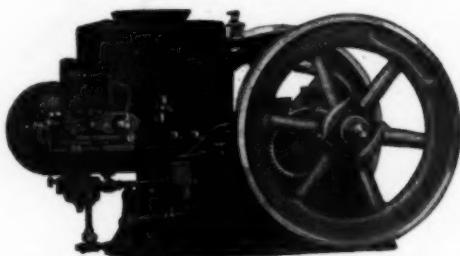
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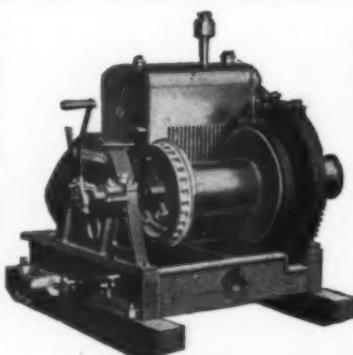
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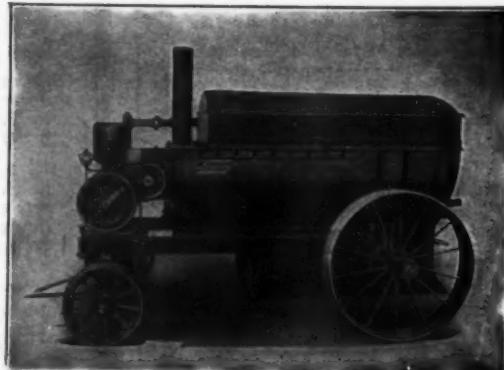


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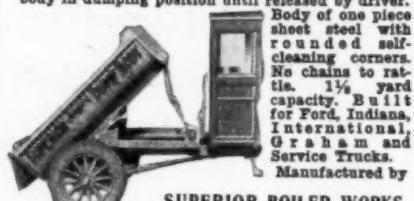
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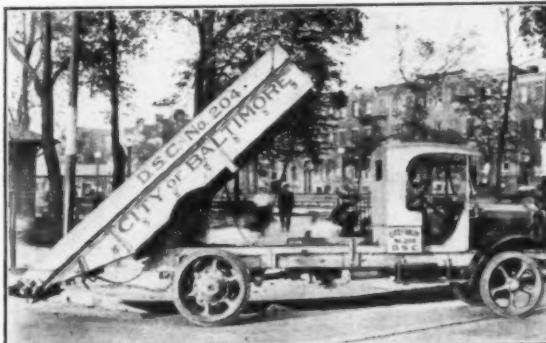
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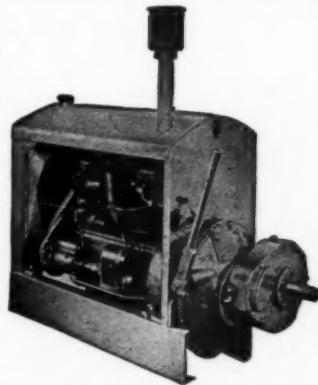
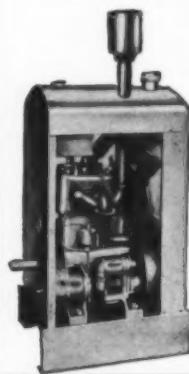
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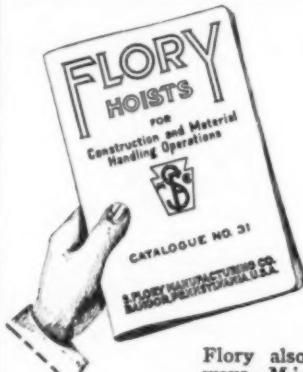
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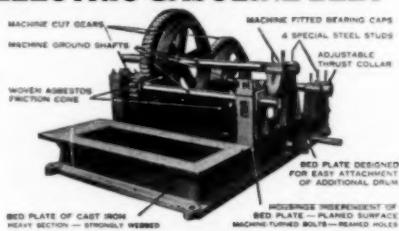
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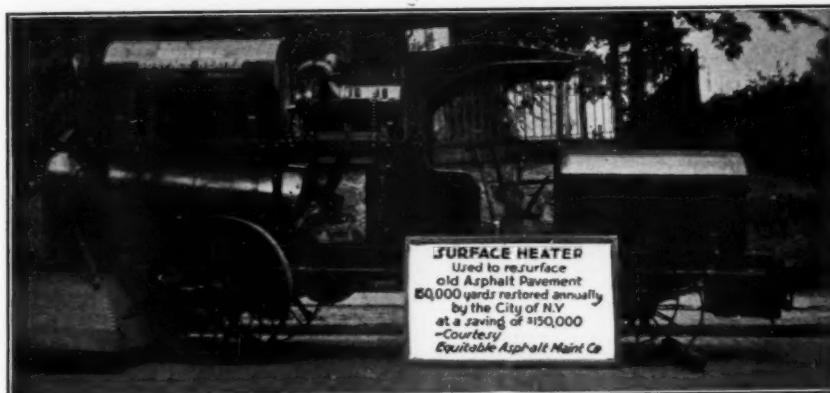
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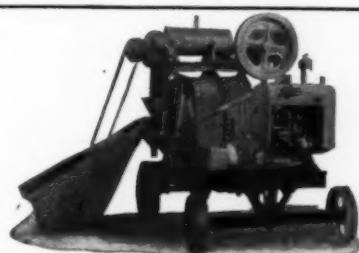
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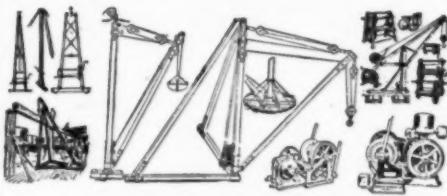
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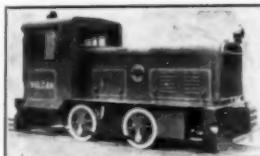
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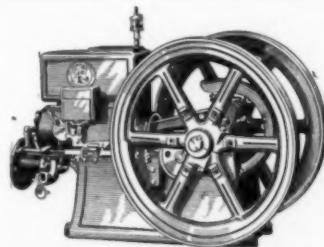
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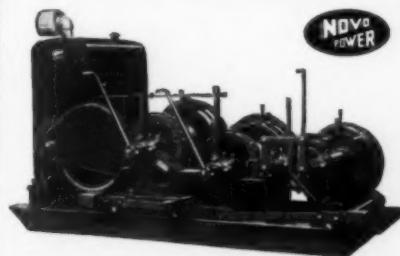
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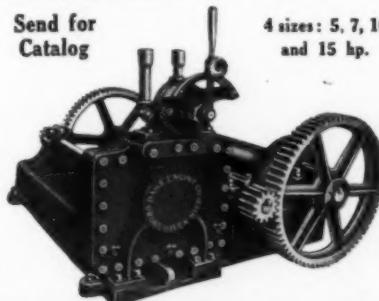
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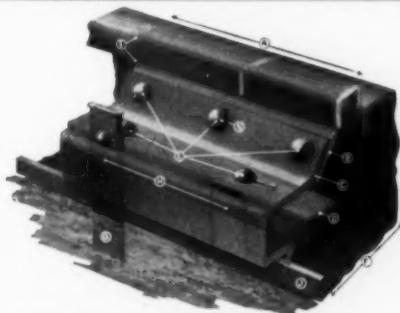
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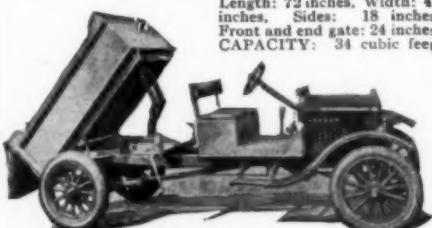
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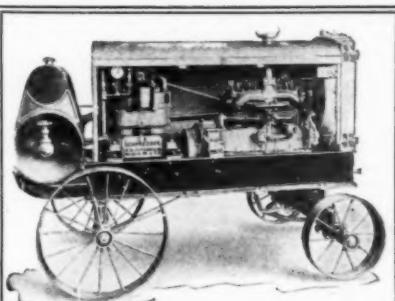
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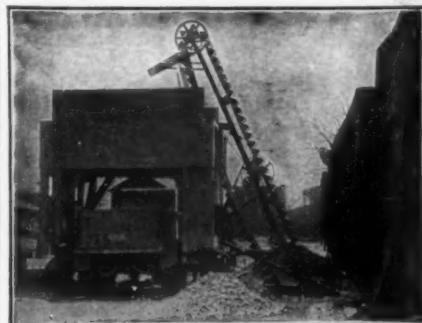


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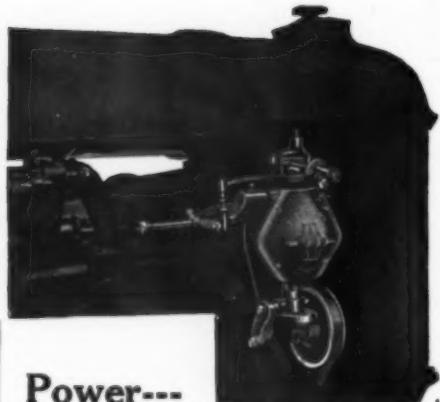
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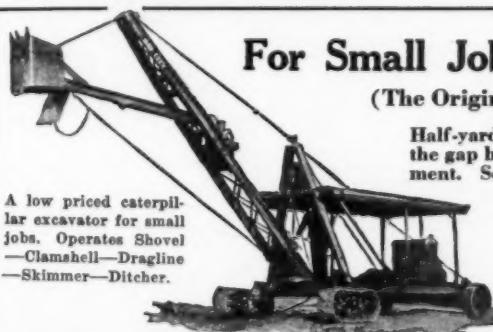
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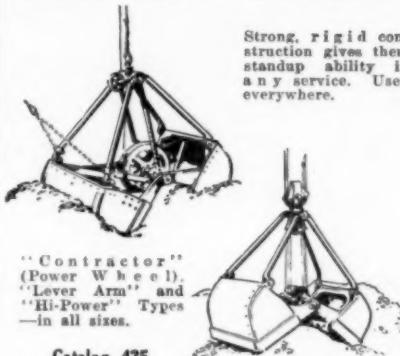
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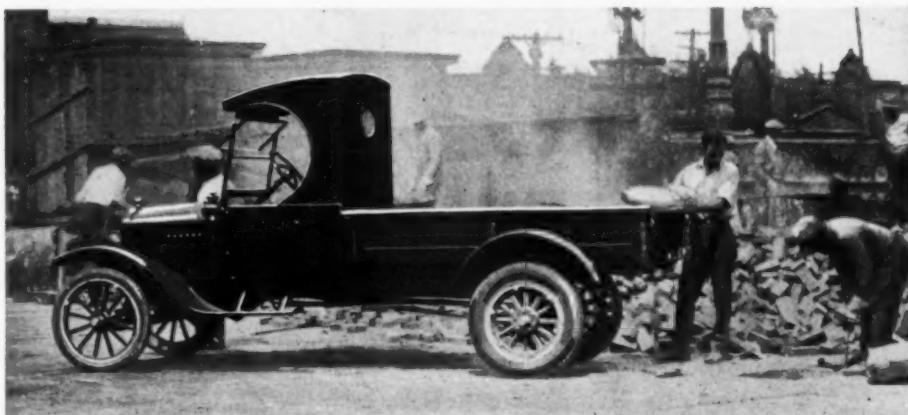
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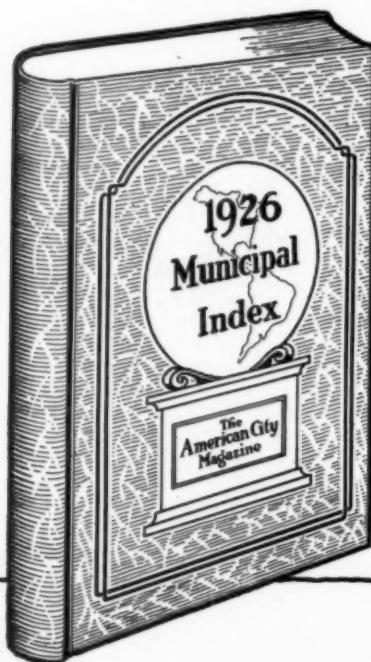
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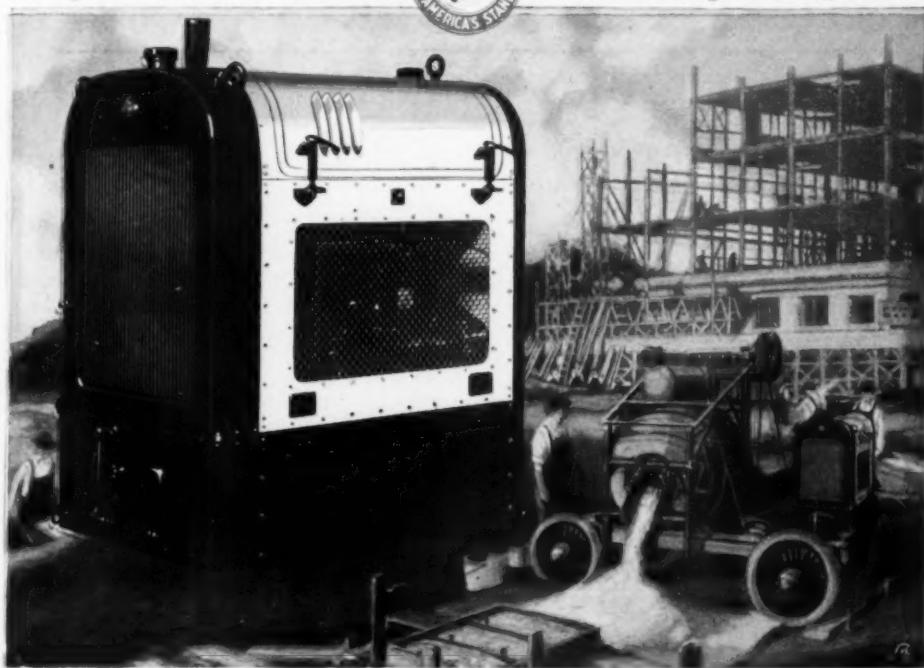
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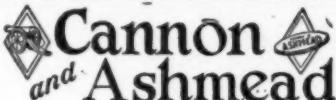
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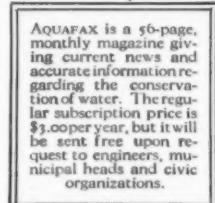
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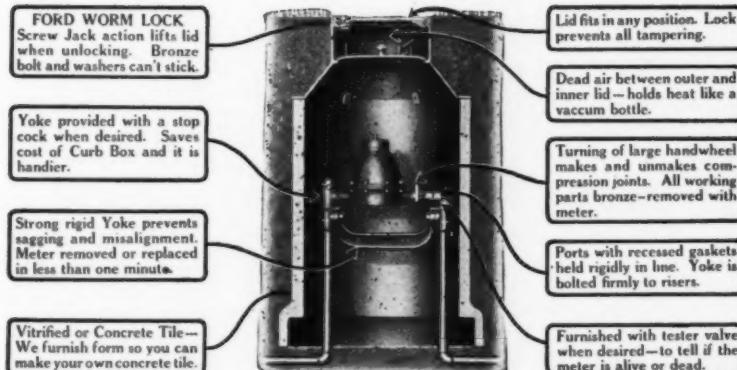
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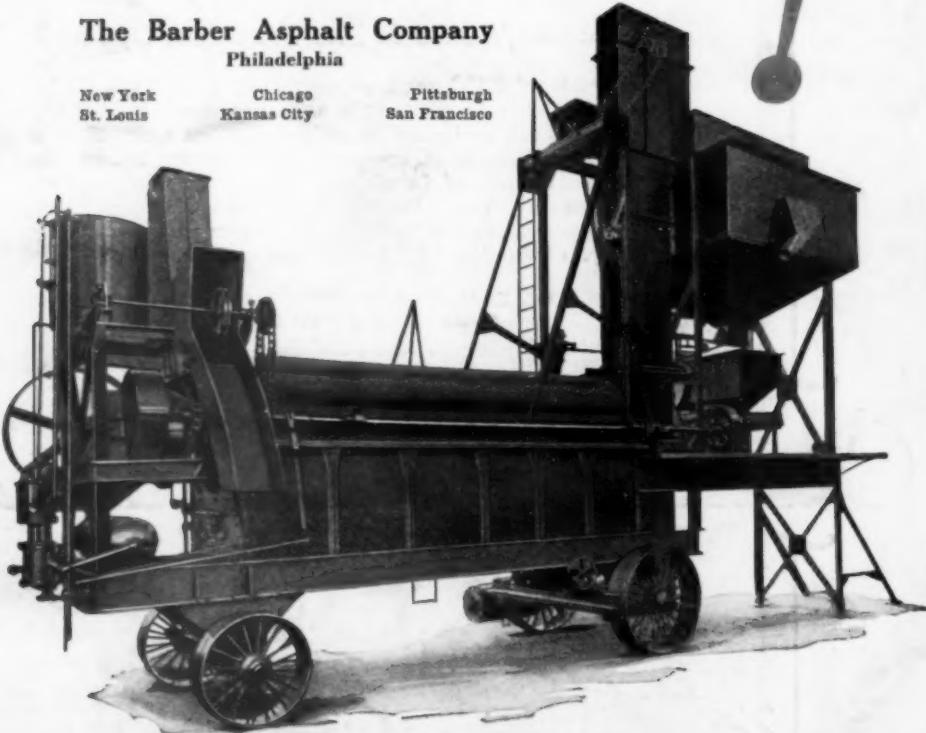
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